THURSDAY, JULY 19, 1894.

ANCIENT ASTRONOMY.

Recherches sur l'histoire de l'Astronomie Ancienne. Par Paul Tannery. (Paris : Gauthier-Villars et Fils, 1893.)

THE author's previous work, "Pour l'Histoire de la Science hellène," in which early Greek scientific ideas are treated of from the time of Thales to that of Empedocles, and which first appeared in fragments in the pages of the *Revue Philosophique*, leads the reader to open the present with high expectations, which its perusal will assuredly not disappoint. It in no degree trenches upon the ground occupied by the former; but its main object is to furnish an analysis of the Almagest, more accurate and complete than those given by previous writers, and also to discuss the views of those who may fairly be called the precursors of Ptolemy, and especially of Hipparchus. On this latter point M. Tannery's researches have led him to conclusions somewhat different from those which have been generally entertained. The part played by Hipparchus in the progress of astronomy he considers to have been singularly exaggerated, and the ground to have been prepared rather by the earlier writers of the Alexandrian school, particularly by Apollonius of Perga, in the invention of geometrical and trigonometrical methods, and the first systematic combination of recent with earlier Chaldean observations. To illustrate clearly his meaning, he affirms that, without these previous works, Hipparchus would have been unable to accomplish the greater part of that which has made his name immortal; whereas without that of Hipparchus, Ptolemy would have been able in great measure to have composed his Almagest; it would have been undoubtedly much more imperfect and less accurate in many numerical details, but "l'ensemble ne présenterait pas un caractère très notablement différent."

The work begins with an etymological discussion (certainly conducted on historical principles) of the origin of the words (*i.e.* of their Greek equivalents) "astronomy" and "astrology." The former is the older of the two, and is found in Plato and in Aristophanes; the substitution of "astrology" was made by Aristotle. Hipparchus preferred the term mathematician to astronomer or astrologer; and following in his wake, Ptolemy called his great work (for which we usually use the Arabic designation "Almagest") the mathematical composition. It may be interesting to remember that though in modern times the expressions astronomy and astrology returned into use (at first with the same meaning, but the latter became degraded by exclusive application to absurd and superstitious attempts, in the manner of the Chaldeans and Egyptians, to predict future events by supposed planetary influences), yet Flamsteed's favourite way of designating himself was as M.R., for "mathematicus regius." M. Tannery thinks that the term ἀστρονόμος preceded that of ἀστρονομία, and that it strictly signified one who distributed the stars into groups, or, as we call them, constellations. With regard to the well-known passage in Homer, speaking of the Bear that alone has no part in the baths of the ocean, he takes the poet to include under that name all the stars within the circle of perpetual apparition. The knowledge of the distribution of the stars in the visible firmament was obviously of use in navigation; the extension of this astronomy to reasoning on their motions, for which the expression astrology was afterwards logically preferred by Aristotle, was, we are told by Xenophon, discouraged by Socrates; but the language of the historian rather points to the works of Eudoxus of Cnidus, which appeared subsequently to the time of Socrates.

M. Tannery takes occasion to allude to the famous story or legend of the number of the year in the Metonic Cycle taking its name from its being graven in golden letters on a public square in Athens; whereas Boeckh has proved that the cycle in question was not brought into use there until the reform of Calippus, a century after the time of Meton, and Aristophanes in more than one passage ridicules the disorders of the calendar in his own time.

In his second chapter, M. Tannery treats of the progress made in the science which acquired the name of astrology (but for which modern science prefers the more ancient term astronomy, to avoid confusion with what Kepler called its hair-brained sister, though we refuse to recognise any relationship, and it was felt to be too much trouble always to call the other judicial astrology) during what may be considered the Athenian period, for thither came Eudoxus, who founded the school of Cyzicus and introduced the use of the instrument called the ἀράχνη, identical in principle with the astrolabe, the invention of which was long falsely attributed to the Arabs; and there also Calippus conferred with Aristotle. But Alexandria was destined to take the place of Athens as the principal seat of Greek learning. It was, however, to the second period of its prosperity, under the Roman domination, that the astronomical glory of Alexandria culminated in the hands of Claudius Ptolemy, whose work may be said to comprise all that was known of astronomy until the era of Copernicus and Tycho, soon to be followed by that of Kepler and Galileo. Meanwhile one of the islands on the coast of Asia Minor, on which, according to the Greek proverb, the sun always shone, so that it may be presumed that the stars also frequently did at night, had been the scene of the scientific labours of Hipparchus, probably the best known amongst the ancient astronomers. Mr. Chambers calls him "the Newton of Greece," but it is evident that M. Tannery does not share that view at any rate. The illustrious Bithynian is usually considered, he says, "comme un génie absolument hors de pair"; but without desiring in any way to depreciate his very important contributions to science, he adds, "L'importance de son rôle est en tout cas assez grande pour que ce ne soit pas lui faire injure que d'essayer de le ramener à des proportions un peu plus humaines. Il a possédé, sans contredit, les qualités essentielles à un astronome; habile et patient observateur, calculateur émérite, il fut également doué de la sagacité qui conduit aux découvertes capitales et de la puissance de déduction qui permet d'enchaîner les vérités nouvellement acquises dans un système solidement construit. Eut-il, au même degré, le génie de l'invention mathématique? C'est ce qui semble pouvoir être mis en doute."

The author proceeds to show that in many of the

advances usually attributed to Hipparchus, especially those in which mathematical acumen was requisite, he had been preceded by others, though undoubtedly his store of observations was of great value to his successors, and in practical methods he made many and important inventions. "Trigonometry," we read in the article on Ptolemy in the Encyclopædia Britannica, "was created by Hipparchus for the use of astronomers." M. Tannery gives reasons for believing that his qualifications were not of a kind to enable him to make discoveries of this nature, whilst as for the systematic development of the hypothesis of epicycles and eccentrics to represent the celestial movements (which, since the time of Kepler, "n'est plus que l'objet d'un dédain qu'à vrai dire, elle ne mérite guère en elle-même"), the testimony of antiquity attributes this to the great geometer, Apollonius of Perga. Even in the systematic utilisation by Hipparchus of the ancient Chaldean observations of eclipses, he had probably to a great extent been anticipated by Conon of Samos, best known as the friend of Archimedes, and for his ingenious flattery of the Egyptian queen by raising her hair to the heavens as the constellation Coma Berenices. Seneca, it is true, speaks of Conon's use of Egyptian observations; but this was in all probability an error for Chaldean, brought about by the astronomer's residence in Egypt. It would seem, in fact, that Hipparchus should rather be compared to Flamsteed than Newton amongst the moderns. M. Tannery goes on to dwell upon the mathematical importance of the work of Apollonius, who was probably the same as the astronomer of that name who also lived under Ptolemy Philopator, and was called Epsilon on account of his researches on the theory of the moon; the old ordinary form of that letter resembling a crescent.

Geminus and Cleomedes (whose native places are unknown), Theon of Smyrna, the elder Pliny, are passed in review; but the principal part of the work before us respects, as before said, the great composition of Ptolemy, of which a very complete and interesting account is given. The ancient astronomer who, unknown to Copernicus (as it appears only from a work of Archimedes inaccessible to him), had anticipated him in the theory of the earth's motion, was Aristarchus of Samos. But, however worthy of admiration this may be, "on ne doit nullement exagérer le tort que subit la science astronomique par le fait qu'Hipparque et Ptolémée ont maintenu le système géocentrique. Au point de vue mécanique et physique, la conception héliocentrique réalisait un immense progrès; au point de vue géometrique, que la science des anciens n'a pas dépassé pour les astres, cette conception ne présentait aucun avantage réel." The position and work of Copernicus is so often little understood, that it may be well here to quote further M. Tannery's language:—

"Le véritable titre de gloire de Copernic est peut-être moins d'avoir réprouvé le système d'Aristarque que d'avoir en même temps, mais à la suite d'un travail considérable et tout-à-fait indépendant de ce système, simplifié extrêmement les hypothèses relatives aux épicycles et excentriques, tout en conservant les mêmes principes géométriques que les anciens pour l'explication des mouvements des planètes."

The space at our disposal renders it quite impossible to do more than offer some indications of the contents of a work of which we may well say with Osiander of that of Copernicus, "eme, lege, fruere." But we may be permitted to express our concurrence with its closing remark:—"En tout cas, on ne pourra se refuser à admettre cette vérité que *la science ne se développe que lorsqu'elle est cultivée pour elle-même;* voilà sans doute la plus solide conclusion que l'on puisse tirer de son histoire."

There are several interesting appendixes, particularly those on the trigonometry of the ancients, on the great year of Josephus, on the conjectural opinions of the ancients concerning the distances of the planets from the earth, and one (by M. Carra de Vaux) on the celestial spheres of the Persian astronomer Nasir-Eddin Attûsi (born at Tûs in Khorasan, A.D. 1200), with a translation of part of his work. But there is not, what there certainly should be, a general index to the whole. W. T. L.

SCOTTISH LAND-NAMES.

Scottish Land-names. By Sir Herbert Maxwell, Bart., M.P. (Edinburgh and London: W. Blackwood and Sons, 1894.)

THIS book is practically a collection of a course of lectures called the "Rhind Lectures in Archæology," published "just as they were delivered." Sir Herbert Maxwell has done well to print them, by way of furnishing material for future workers, amongst which we may hope that he may himself make one.

The book furnishes a large number of notes and suggestions; and good work might be done by some philological scholar, who would go over the suggested etymologies, and verify them one by one. It is tolerably certain that some of them will not stand any very rigid test; whilst others will, no doubt, be found to be quite correct.

The author clearly recognises the great principle upon which all such investigations must be conducted. We must in every case try to find out the earliest written form in some charter or deed; and it will then often be found that such early form wholly contradicts the suggestion which the modern name presents.

"From a charter of the same king (William the Lion) it is evident that Granton, near Edinburgh, is not, as it appears, Grant's-town, like Grantown-on-Spey; for it is written *grendun*, the Anglo-Saxon *grēne dūn*—green hill." Similarly, we may remark, we find in England such names as Grendon and Grindon.

After laying down this all-important principle, it is not a little surprising to find, at the end of the work, an index of place-names, with etymologies, in which not a hint is given of the authority upon which each explanation rests. Thus "the Braid Hills" is explained from the Gaelic *braghad* (braad), the breast; and, of course, if there is documentary evidence for it, there is no more to be said. But if not, it is by no means clear why *braid* may not be the ordinary Lowland-Scotch word for "broad." In every such case, we have a right to expect that the evidence should in some way be given; precisely as, in Bardsley's book on Surnames, the whole value of the work really resides in the copious lists of references which are given at the end of it.

We have noted a considerable number of other points on which we desire further information. The remarks

on the pronunciation (which is rightly said to be of great importance) are frequently bewildering. It may be well to point out two typical instances, for the bettering of the book in a future issue.

"Broad-ford in Skye retains the full sound of the Norse *breidr fjördr*, broad firth" (p. 84). This is precisely the thing which it does not do. *Broad* is not Norse, but Southern English; and *ford* suggests the word *ford* rather than *firth*.

"*Völlr*, a field, generally becomes *wall* in composition, as Dingwall in Ross-shire" (p. 89). Here "becomes" really means "is represented by"; for, as a fact, the form *wall* shows a far older stem, in which the *w* has not yet become *v*, and the *a* has not yet been treated with the *u*-umlaut. In other words, it would be far more correct to say, conversely, that the old stem *wall* has become *völlr* in the nominative case of the modern Icelandic word.

One thing, at any rate, must go. And that is, the extraordinary definition of *umlaut* on p. 39. "The law of *umlaut*, as the German philologers call it, whereby the vowel-sound in one syllable is altered by the vowel-sound in a syllable following (all fairly well so far, but mark the sequel), as *husband* and *nostril* stand for *house-band* and *nose-thrill*." Certainly, no German philologer ever said anything of the kind. The *u* in husband and the *o* in *nostril* are not examples of *umlaut* at all, for they do not depend in the least upon the vowels *a* or *i* in the second syllable. They simply exhibit examples of vowel-shortening before a collection of consonants, which is a different thing altogether. This is indeed a sentence to induce doubt in the author's methods.

Nevertheless, the book has its place and use. The collection of examples is a thing to be thankful for; and we heartily commend the author for attempting it. But, oh! that he had produced his authorities in every possible case, and had told us where the guesses come in!

OUR BOOK SHELF.

Systematic Survey of the Organic Colouring Matters. By Drs. G. Schultz and P. Julius. Translated and edited, with extensive additions, by Arthur G. Green. (London: Macmillan and Co., 1894.)

THE German edition of this standard work of reference has already been reviewed in these columns (vol. xlvi. p. 313). The translator and editor has done good service in rendering the work more available to English technologists by adding a preliminary section on the raw materials used in the industry, as well as by giving prominence in the tables to English patents. In these particulars the present edition differs from the German, and its value from the English point of view is thereby greatly enhanced. The work is also brought up to date, as all the later discoveries are tabulated. The total number of colouring matters now recorded is 454, as against 392 in the last German edition (1891). Even while Mr. Green was preparing the translation new products were being introduced, and no less than twenty-two new compounds have had to be added in an appendix. Another valuable addition to the English edition is the synoptical table for the qualitative analysis of artificial colouring matters, which was published by the translator last year in the *Journal* of the Society of Chemical Industry, and which is reprinted at the end of the volume.

One reflection which occurs in looking through the tables is the very unfair action of our patent laws upon English manufacturers. Most of the new discoveries are patented by German, French, or Swiss firms in this country, but the patentees do not make the products here—their patents simply blockade the industry in Britain, without giving our manufacturers any benefit. On the other hand, it is well known how stringent is the attitude, especially of the German Patent Office, in granting patents to foreign inventors. But this is a side issue, suggested only by the large number of references to English patents in the tables before us. Of these tables and of the work as a whole we have only to say that it will be welcomed by manufacturers and students as the latest and most complete synopsis of the organic colouring matters that has hitherto been drawn up.

R. M.

A Handbook to the Marsupialia and Monotremata. By Richard Lydekker, B.A., F.G.S. (London: W. H. Allen and Co., 1894.)

MR. LYDEKKER'S capacity for book-making seems to be unlimited. Zoological science is indebted to him for the diffusion of accurate knowledge on the fowl of the air, and "every living thing that creepeth upon the earth" and moves in the sea, from the days when the icthyosaurus disported itself in the Jurassic ocean to the present enlightened age. He is not, however, a brilliant writer, and all his works possess a sameness of diction, the dead level of which becomes oppressive after a time. The volume under review is a "popular monograph," in which the Marsupials and Monotremes are taken in order and have their characters, distribution, and habits detailed in a more or less attractive manner. These interesting mammals are dealt with one after another, and their characteristics are described in a way that strongly reminds us of the verbal expositions of the guide of a menagerie. The thirty-eight excellently coloured plates, with which the book is embellished, help to render the analogy more realistic. This monotony, however, is probably unavoidable in a work having the scope of Mr. Lydekker's handbook, and, in fairness to him, we must say that he has struck a good compromise between zoological treatises bristling with technical details, and works designed for the profoundly ignorant. It is almost unnecessary to say that the book is thoroughly up-to-date as regards recently discovered species, one of the most interesting of these being the remarkable Marsupial Mole described by Dr. Stirling a few years ago. With the exception of the matter relating to a few species, the book is founded upon Mr. Oldfield Thomas's "Catalogue of the Marsupialia and Monotremata in the Collection of the British Museum" (1888), with the addition of some notes on fossil species of these Orders. Mr. Lydekker has made an admirable and handy abridgment of this "indispensable compendium," and his work, though stodgy in places, will well serve the purpose of a popular book of reference on Australian mammals.

Climbing in the British Isles—England. By W. P. Haskett Smith, M.A. Pp. 162. (London: Longmans, Green, and Co., 1894.)

MOUNTAINEERING is a passion. Men who have climbed, rarely, if ever, get rid of the unrestful instinct to scale unconquered peaks and wriggle through unexplored "chimneys." This love of climbing has been growing in England for some years past, and Mr. Haskett Smith's book will certainly assist in extending it still more. The book is the first of a series describing the climbs available in the British Isles, two complementary volumes, dealing respectively with Wales and Scotland, being in preparation. It is not, of course, suggested that hill-climbing in these islands is the same as mountaineering in the

Alps, but it is rightly held that the man who goes through a course of training among the crags of Cumberland qualifies himself to tackle the giants of the Alps or Caucasus. Beginning with the tors on Dartmoor, the would-be Alpinist can pass by easy stages to such climbs as those of Deep Gill, Mickledoor and Napes Needle, and then complete his course of instruction on the Alps. For convenience of reference, all the headings are arranged in alphabetical order. It is easy, therefore, to turn up information about hills or rocks which afford climbs, and to find the meaning of technical terms and expressions. It would have been an advantage, however, if Mr. Smith had given a list of climbs in the order of difficulty, for beginners would then know exactly where to commence their mountaineering education. The book is illustrated with twenty-three sketches by Mr. Ellis Carr, and five plans. It will doubtless increase the number of climbers, and the many admonitions it contains ought to keep down the mortality from what someone has called the "greasy pole" exercise.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Trituberculy and Polybuny.

IT is a matter of regret to me that so clear-headed a naturalist as Dr. Forsyth Major should have misunderstood what I thought to be clear intelligible language.

In his letter (NATURE, May 31) Dr. Forsyth Major declares that, in my paper on the Stonesfield mammalia, I stated that he has expressed views in his paper on Squirrels (*P. Z. S.* 1893) the very reverse of those recorded by him in that paper. All that I have said about Dr. Major, whose paper I read after writing mine, is "Dr. Forsyth Major does not favour this view," viz. that all the various forms of lower molars of Ditrematous mammals can be derived from the tubercular-sectorial type. I shall be glad if Dr. Forsyth Major will either state that he *does* favour this view, or withdraw his charge of misrepresentation.

Again, I think, Dr. Major has misunderstood my words when he proceeds to declare that I have made "some obviously contradictory statements" in my paper on the Stonesfield mammalia, and in my letter to NATURE of May 3. The object of my remarks on the primitive mammalian tooth in my paper, was to show that that part of the "tritubercular theory" (as lately set forth by Profs. Cope and Osborn) which seeks to explain the tubercular-sectorial tooth as having arisen—within the mammalia phylum—from a single cone through a triconodont stage is beset with weaknesses and improbabilities which render it untenable. The view there expressed that the Pro-mammalian molars "were of an indefinite multituberculate pattern," or, in other words (used in my letter), that they were "provided with many cusps not placed in one line," is *not* inconsistent with the admission that the common ancestors of the Marsupials and Placentals—and even (if we accept Prof. Osborn's latest statements) of the so-called "multituberculata"—may have already developed tubercular-sectorial lower molars, and perhaps tritubercular upper molars. Dr. Forsyth Major, whose careful observations deserve great consideration, has argued, in his letter of May 31, very forcibly against this "working hypothesis." I think it only right to say that the views expressed by him are identical with those which have been urged on me privately, and also expressed in lectures, by Prof. Lankester, under whose direction I made my investigation of the Stonesfield jaws.

The theory I support, then, merely comes to this: that many-cusped teeth of indefinite pattern (such as those of Ornithorhynchus?) gave rise to tubercular-sectorial lower and, perhaps, tritubercular upper teeth, some of which in turn gave rise to many-cusped teeth of definite serially tuberculated pattern (Polymastodon, &c.). Prof. Osborn declared that he had evidence of the latter step. The one mistake to which I plead guilty is that of having apparently endorsed in my letter Prof. Osborn's view on this latter point. In reality I wished to be understood as admitting temporarily—and until further evidence comes to hand—a statement which I was not in a position to combat by the use of my own observations.

Oxford, June 4. E. S. GOODRICH.

A Review Reviewed.

I AM rather astonished at the criticism of my use of the term mineraliser in my book on the "Economic Geology of the United States," made by a reviewer in a recent number of NATURE. Surely the sanction of the Century, Webster, and Worcester dictionaries, besides several scientific works, should be considered as warranting my use of the term, unless some very serious objection can be urged.

Since I am writing on the subject, I may say what perhaps should have been said in my preface, that the mineralogical part of the book, to which exception is taken by the reviewer, was not intended to teach mineralogy, but to call attention to a new aspect of the subject—the economic. The students for whom the book was mainly written, those at Cornell University, have, when they begin the study of economic geology, already studied determinative mineralogy and blowpipe analysis, and they have also studied rock-forming minerals from the geological standpoint. Here is the third standpoint, and experience in teaching shows that the plan is not superfluous.

Objection is also made to the absence of illustrations. But this is intentional, for I believe the class-room is the place for these. There we can use large illustrations, lantern-slides, and original maps and sections, which are vastly better than text-book diagrams.

I wish also to make an acknowledgment. As the reviewer points out, and as others have done before him, the chapter on mining terms and methods is weak and in places inaccurate. It was a serious error on my part (for which the book has suffered) not to have submitted this chapter, upon which I have only second-hand knowledge, to some specialist for revision. At present the only thing that can be done is to promise the elimination of the objectionable parts in a second edition, if one is called for. RALPH S. TARR.

Cornell University, Ithaca, N.Y., June 29.

I WILL reply *seriatim* to the various points of Prof. Tarr's letter.

(1) *Term "Mineraliser."*—I still think the word objectionable in the sense used by Prof. Tarr. To most people it probably conveys the idea of something which converts or helps to convert another substance into a mineral. How can sulphur be said to "mineralise" silver by combining with it? Both the elements already exist as minerals in nature; and one might just as well say that the silver mineralised the sulphur.

(2) *Mineralogical part of the book.*—Prof. Tarr states that the object of this part of the book is not to teach mineralogy, but to call the attention of students to the economic side of the question; but this is no excuse for loose and careless writing, instances of which are far too numerous. We read on page 16: "When a metal is combined with silica (SiO_2), a silicate is formed." "Ores considered from the economic standpoint occur in beds or in veins" (p. 17); this would lead the student to infer that no other modes of occurrence are known. Iron pyrite "grades into copper pyrite, but when there is much copper present the colour becomes more golden" (p. 18) "Grade" as a neuter verb does not appear in my edition of Webster, but it probably is intended to mean "gradually passes into." This reading is confirmed on page 22, where we find "copper pyrites, which is in reality a sulphide of iron and copper combined, the proportion varying from an exceedingly cupriferous variety (chalcopyrite) to pure iron pyrites." Limonite is spoken of as "the rust of hematite" (p. 19). Tin ore "is found both as tinstone, in coarse granites or pegmatites, and as stream-tin" (p. 25). Is not stream-tin a form of tinstone, and may not tin ore be found in *fine-grained* granite and in slate?

Judging from the paragraph on page 26, the author is unaware of the existence of any oxidised ore of nickel. The student does not obtain a correct idea of dolomite by being told that it is carbonate of lime "combined chemically with magnesium" (p. 10). I think that these instances, and others might be quoted, justify my remarks.

(3) *Paucity of illustrations.*—If Prof. Tarr had adhered to

his original intention of merely writing lecture-notes for his class, there would have been some force in his excuse; but when he sends forth his work as "a text-book, with the hope that it may find a wider field," he cuts the ground from under his feet. He must recollect that the majority of his readers will never have the opportunity of seeing his lecture diagrams and lantern-slides. If illustrations are out of place in a text-book, why did the author take the trouble to insert twenty-nine? Surely he is not ashamed of his beautiful and instructive frontispiece.

(4) *Mining chapter.*—After Prof. Tarr's candid confession, I will not say another word likely to cause him pain or annoyance; but will merely express the hope that Professors of Economic Geology, while examining mineral deposits, will take the trouble to notice how they are worked, and so render themselves independent of any second-hand aid when writing upon the art of mining. THE REVIEWER.

Halo of 90° with Parhelia.

ON July 11 the halo of 90°, intersecting a primary halo of the usual size, but intensely brilliant in colouring, was visible at West Newton, Cumberland, for about four hours—9 a.m. to 1 p.m. The sun shone brilliantly all the time. Light strips and wreaths of cirrus and minute mottled cirro-cumulus marked the upper sky. There were several mock suns, not all equally distinct. The halo of 90°, a very unusual phenomenon, was of a pale grey-blue tint, showing no prismatic colours, except in a very slight degree at the point furthest removed from the sun.

This system of halos formed a splendid sight for about four hours, indicating a vast sheet of ice-crystals. I have observed that parhelia sometimes precede heat, as well as stormy weather.

The intensely vivid colouring of the part of the two (almost concentric) halos, where they intersected above the sun, was most striking. SAMUEL BARBER.

West Newton, Cumberland, July 11.

P.S.—Four dry days followed, the fifth *wet*.

Rate of the Flight of Birds.

I SHALL be glad if any of your readers can inform me whether the rate of the flight of any birds other than Homing Pigeons has been accurately measured, and what attempts, if any, have been made to employ birds belonging to other families in place of Homing Pigeons. F. W. HEADLEY.

Haileybury, July 15.

THE UNIVERSITY OF LONDON AND THE REPORT OF THE GRESHAM COMMISSIONERS.

THE University of London is beyond question the Institution most nearly concerned with the recommendations of the Commissioners appointed to consider the draft charter for the proposed Gresham University in London. These proposals, as was pointed out in NATURE in March last (vol. xlix. p. 405), involve the reconstruction of the present University and the formation of a Senate and Convocation having powers differing considerably from those at present possessed by them. Importance would, under any circumstances, attach to the attitude assumed by either body towards the Report, and in the present case it is in no way lessened by the fact that in the charter of 1863 it is ordained that Convocation—that is, those graduates of the University who have attained a certain seniority and paid certain fees—shall have "the power of accepting any new or supplementary charter for the University, or consenting to the surrender of this our charter, or of any new or supplemental charter," the consent of the Senate being also requisite before either acceptance or surrender becomes operative. This power of veto was exercised by Convocation in 1891, when a draft charter proposed by the Senate was rejected by a large majority, and the way made clear for University and King's Colleges to proceed with their petition for a separate University.

The preparation of a scheme for engrafting teaching on the present examining functions of the University of London did not originate with the Senate. To Convocation belongs the distinction of being the first to advocate this enlargement of the scope of the University, and its proposals were embodied in a scheme as long ago as 1886, while in a later scheme submitted to the Commissioners it indicated in still further detail the lines on which in its opinion a solution of the question might be found. The inability of each body to accept the schemes of the other, the chronic division of opinion between the Senate and Convocation on the Teaching University question, did not augur well for a joint assent to any scheme resulting from the labours of the Commissioners appointed in 1892.

This contingency evidently presented itself to a large majority of the Commissioners, since, with a wisdom which seems likely to be justified by events, they have gone beyond the terms of reference, which contemplated "the establishment under charter of an efficient Teaching University for London," and say that "in view of the failure of previous attempts to settle this question, and of the difficulty and delay which must inevitably attend an alteration of the constitution of the University through the action of the University itself, we are of opinion that, in accordance with the precedents followed in other cases of University reform, the changes which we recommend should be effected not by charter, but by legislative authority, and by the appointment of a Commission with statutory powers to settle, in the first instance, arrangements and regulations in general conformity with the recommendations which we are about to submit to your Majesty."

The latest project for the inevitable extension of University education in London was speedily recognised by many as a well-considered and feasible plan for meeting the requirements of the case. Highly desirable as it was that it should be accepted by, and not forced upon, Convocation, yet at first the outlook was anything but bright. The Annual Committee of Convocation—the body of graduates elected every year "to advise Convocation upon any matter affecting the interests of the University"—undertook the preparation of a report on the scheme of the Commissioners for presentation to Convocation. While this was under discussion an interview took place between it and the Committee of the Senate charged with the consideration of the Commissioners' Report, and it may be inferred that exception was taken to the revocation of the veto and to the mode of procedure proposed by the Commissioners, since the Chancellor (Lord Herschell), in the course of his reply, is reported to have said: "If the proposals of the Commissioners were generally considered to be for the public good, and a reasonable solution of the problem that had been referred to them, it would scarcely rest with this University, either through the Senate or through Convocation, to veto the plan; nor should the remodelling of the constitution of a public body, with a view to its further efficiency, be regarded as a penal abrogation of its charter."

Disregarding this statesmanlike view of the situation, the Annual Committee the same evening adopted a Report wholly adverse to the proposals of the Commissioners, and drew up five resolutions which they recommended Convocation to adopt. Space will only permit reference to the first: "That Convocation protests against the withdrawal without its consent of the charter of the University of London as proposed by the Gresham Commission . . . ." and the fourth: "That Convocation therefore, although it would regret the establishment of a second University in London, is of opinion that it would be less disastrous to establish such a University with a

distinctive title than to carry into effect the scheme of the Gresham Commissioners." These will sufficiently indicate the Annual Committee's views.

Convocation's method of conducting business, it may be hoped, is peculiar to itself. Although an extraordinary meeting was convened on April 10 "to consider the Report of the Commissioners appointed to consider the draft charter of the proposed Gresham University in London, and also the Report of the Annual Committee thereon," it was debarred from expressing its opinion, either by discussion or vote, on the Commissioners' Report *as a whole*, and directed to confine itself to such matters as arose out of whichever resolution of the five might be under debate. After much fruitless discussion the resolutions proposed by the Annual Committee were unanimously set aside in favour of a motion which, "with a view to the speedy and satisfactory reconstitution of the University," referred "the whole question of the constitution of this University to the Annual Committee with power to nominate members of a Joint Consultative Committee of the Senate and Convocation."

This motion, agreed upon at the close of a protracted meeting and devoid of any express instructions to the effect that delegates should be selected so as to represent interests and not individuals, and that the Commissioners' scheme should form the basis of conference, was no doubt unfortunately worded, but the use to which it might be put was certainly not foreseen at the time of its adoption. In its seconder's opinion, as stated in a letter to the *Times*, "should such a Committee arrive at a workable result, this may be embodied in a new charter which may be accepted without resort to a Statutory Commission, such as the Annual Committee objected to," in other words, the Consultative Committee might be the means of indefinitely postponing the settlement of the question of University reform. And the Annual Committee, having failed to carry its resolutions, must have taken much the same view, since its delegates were, with one exception—that of a theologian—chosen entirely from its own body, while on points of order raised by two of its members in connection with the motion, discussion on the Commissioners' Report at the ordinary meeting of Convocation on May 8 was again prevented, although a notice of motion expressing general approval of the scheme was allowed to appear on the *agenda*.

Tactics such as these not infrequently meet with the reward they deserve. University reform in London has waited too long for an obstructive and dilatory attitude, whether arising out of questions of "dignity" or of inability to take a broad view of the problem, on the part of a few, to be tolerable, and fortunate it is that a salutary change has taken place in Convocation itself. A movement in favour of the Gresham scheme took definite shape a few days after the extraordinary meeting on April 10; a Committee of Graduates was formed and a circular sent out to elicit from members of Convocation an expression of general approval of its provisions, and a direct vote in Convocation on the scheme being prevented, its adherents took the only course open to them, turned out the old Annual Committee on May 8, and replaced it by one almost wholly favourable to the Commissioners' proposals. Although not a direct vote in favour of the scheme, it has with good reason been regarded as tantamount to this, since the meeting which elected the new Annual Committee would certainly have expressed general approval of the Report had not the motion to this effect been ruled out of order by the chairman.

Since May 8, events have moved rapidly. The delegates appointed by the late Annual Committee, with one exception, resigned their seats on the Joint Consultative Committee as a result of the vote adverse to themselves, and the Joint Consultative Committee with its endless opportunities for delay has been shelved. The circular issued by the Committee of Graduates just mentioned obtained 856 replies, many of them from the best known and most influential members of Convocation, expressing "general approval of the Commissioners' Report"; and this fact with a list of signatories was embodied in a memorial praying the Senate to "use all its influence to induce the Government to appoint a Statutory Commission forthwith." At its meeting on June 13, the Senate, happy in its opportunity, passed almost unanimously a resolution in which general approval of the proposals of the Commissioners was expressed, and instructions given to its special Committee to consider suggestions for the terms of reference to the Statutory Commission. A fortnight later the Annual Committee and other invited graduates met the Special Committee of the Senate in conference, and on behalf of the former it was urged "that it is desirable to memorialise Government to take immediate steps for the appointment of a Statutory Commission to frame statutes in general accordance with the Report of the Gresham Commission, with full power to make such modifications as they may see fit, after conference with Convocation and other bodies affected." Further, four delegates from the Annual Committee attended the meeting on June 30, of representatives from nearly all the institutions which, according to the Commissioners' proposals, will form constituent colleges of the reorganised University, and concurred in the resolution of similar character, which, as reported in NATURE (this vol., p. 227), was passed unanimously by those having the right to vote as delegates. And now the welcome news has transpired that at its meeting on July 11 the Senate passed a resolution urging the immediate appointment of a Statutory Commission with power to modify details of the Gresham Commissioners' scheme if judged expedient after conference with the bodies concerned, and that copies of the resolution were forwarded to the Lord Chancellor, the Lord President and the Vice-President of the Council, and the Home Secretary.

The unexpected, therefore, has happened. In every way in which it has been permitted to do so, Convocation, like the Senate, has expressed general approval of the Commissioners' proposals, and the University of London instead of being placed, by divided counsels, in a position deplorable to all friends of higher education in London, is now at the head of the movement for a University worthy of the greatest city of the world. Now that extensive approval of the Report by the great majority of the institutions concerned has satisfied the condition laid down by the Home Secretary as one to be complied with before action could be taken by the Government, it may be hoped that before Parliament is prorogued an Act appointing the Statutory Commission will be added to the legislative achievements of the Session.

W. PALMER WYNNE.

THE OXFORD MEETING OF THE BRITISH ASSOCIATION.

SINCE the last account of the preparations for the meeting of the British Association on August 8 appeared in these columns, the local arrangements have made steady progress, and the arrangements for the Sectional and other meeting rooms are nearly complete. It may be well to explain that only a few of the Sectional meeting rooms can be darkened for the use of a lantern. It has been found impracticable to darken the large writing rooms in the Examination Schools in which Sections E and F will meet; and the same may be said of Hertford College Hall (Section C) and Keble College Hall (Section F). The Clarendon Laboratory Theatre (Section A), the Anatomical Theatre and Laboratory (Sections D and H), and the Physiology Theatre, are provided with dark blinds; and the large Lecture Theatre

in the Museum will be available for meetings of Sections in which the lime-light is indispensable. The dates and hours at which this room will be available must be settled by the Recorders of Sections during the meeting.

The arrangements for excursions in the neighbourhood are now complete. The list is not as long as has been the case in some recent meetings, as the localities of general interest which are accessible from Oxford are few in number. On the Saturday afternoon parties will be taken to Dorchester and Wallingford, to Abingdon, to Blenheim Palace and Woodstock, and to the Roman remains at Silchester, and Prof. Green will take a geological party through Fawler to the classical grounds of Stonesfield. On the Thursday, whole day excursions are arranged for Windsor and Eton, Warwick and Stratford-on-Avon, Compton Wynyates, Broughton and Wroxton, Reading, and the Great Western Railway Works at Swindon.

The total number of those who have up to the present signified their intention of attending the meeting amounts to a little over 1500. As the Sheldonian Theatre, on the most liberal estimate, will not accommodate more than 1800 persons, and as it is very probable that the number of applicants for places will be greater than this, members and associates are recommended to apply for places in the Theatre for the President's address and evening lectures as early as possible. The allotment of seats will begin on Monday, August 6.

Up to the time of writing, but little information has been received respecting the work of the various Sections. In Section D (Biology) the President, Prof. J. Bayley Balfour, will deal in his address with the aspects of forestry in Great Britain, and among other papers which will be read to the Section, Prof. Ray Lankester will make a communication on chlorophyll in the animal kingdom, Prof. A. A. W. Hubrecht will read a paper on the Didermic blastocyst, and Mr. J. T. Cunningham on the specific and generic characters of the Pleuronectidæ.

In Section E the President, Captain W. J. L. Wharton, R.N., will deal in his address with our present knowledge of the physical conditions of the sea. And among other papers which will be read at the meeting are the following :—Colonel Godwin Austen, on Bhotan; Mr. Osbert H. Howorth, on the Sierra Madre of Mexico; Miss Baildon, on a visit to New Guinea; Mr. D. G. Hogarth, on a recent journey in Asia Minor; Mr. W. H. Cozens Hardy, on Montenegro and Albania; Dr. H. Schlichter, on the natural wealth of British East Africa; Mr. G. G. Chisholm, on the orthography of Place-names; Mr. J. Theodore Bent, on Hadramut; Mr. A. Montefiore, on the equipment of the Jackson-Harmsworth Arctic Expedition; Mr. H. N. Dickson, on the physical condition of the North Sea; M. A. Delbecque, on the lakes of France, and Dr. H. R. Mill, on the geography of the English lakes. The proceedings of the other sections will be announced as soon as they are communicated.

THE BIOLOGICAL INSTITUTION IN BERGEN, NORWAY.

LAST autumn a biological institution was opened in Bergen. It forms part of the museum, the library and collection of which the students are at liberty to use.

The building is of wood, two storeys high. On the ground floor there is one large hall surrounded on three sides by aquaria, which are open to the public on payment of a small entrance fee. Then there is the pump-room, and other rooms, one of which is used for experiments in hatching, and in the others the collected matter is examined and studied, and the dredges and other instruments are kept. There are two hatching apparatus, each containing eight hatching-boxes. A hatching apparatus for fresh water is much required, so that the biological questions in connection with the salmon-fishing may be worked out.

Fig. 1 is the plan of the ground floor.

The first floor is set apart for scientific work, and consists of two large rooms, the smaller of which is used for chemical work, and is furnished with all necessary apparatus.

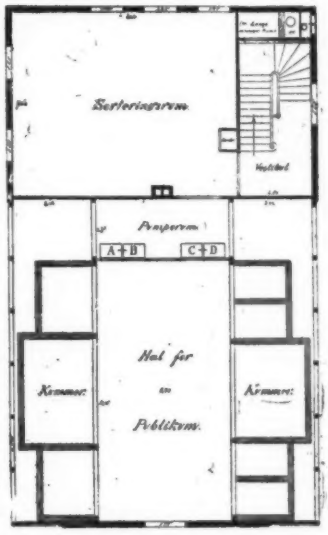


FIG. 1.—Ground floor

The larger room has four windows on each side; those on the east are separated by wooden partitions, curtained off from the rest of the room, thus forming four small work-rooms, each of which is furnished with a microscope and writing-table and other conveniences for the work of one person. In front of the windows on the west side, there are tables (L, M, N, O, Fig. 2).

Altogether ten work-tables are provided in the institute.

In the middle of the larger room there is a long low sink (E, F, G, H, Fig. 2), which has a small channel in the middle connected with a waste-pipe. On each side of this sink, but raised slightly above it, there is a shelf running the whole length of it, and wide enough to hold the small experimental aquaria, which consist of glass bowls. Above the shelves are pipes from the sea-water reservoir, with numerous taps, thus supplying flowing water when necessary.

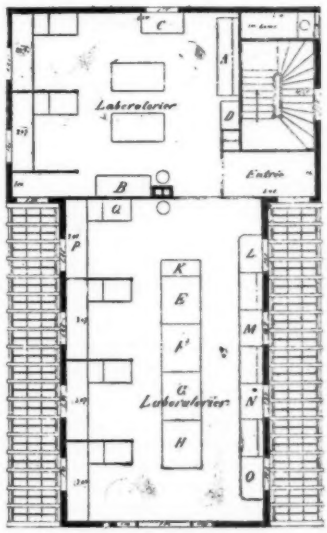


FIG. 2.—First floor.

The sea-water supply is conveyed to the pump-room by means of a long pipe from the middle of the Paddefjords, at a depth of ten metres; from here it is pumped up to the reservoir, which is on the top storey, whence it supplies the laboratories.

The fauna is very rich; the flora has not yet been much studied.

The biological institution is for foreign as well as Norwegian students. The monthly cost for the use of

one of the work-tables is twenty-five kronen. This includes the necessary reagents, the free use of all the apparatus and the museum, also the use of the boat, with the men, for private explorations, and liberty to take part in the weekly steamer excursions to the distant parts of the fjords.

The institution is open every day all the year round; the fjords are never quite frozen, and at the coldest time the temperature is never more than a few degrees from zero.

The institution is under the supervision of Herren Dr. A. Appellöf, G. A. Hansen, and T. Brunchorst. It is almost entirely supported by voluntary contributions. A certain sum, however, is granted by the State, which unfortunately is not sufficient to permit the institution to have a resident zoologist; but as the Norwegian Government is always so liberal in matters of a scientific nature, it is hoped that the required amount will soon be granted.

PROFESSOR DR. FISCHER.

BY the death of Prof. Dr. Fischer, which took place on May 17 last, the Königliche Preussische Geodätische Institut and the Central-bureau der Internationalen Erdmessung lose a very ardent and devoted chief who has done much, not only to keep up the high standard of these institutions, but to bring them, if possible, to a higher grade of perfection.

Born in the year 1836, on December 10, at Deutsch-Leippe, near Grottkau, in Schlesien, Amand Fischer began his first studies at the Mathias-Gymnasium in Breslau, occupying his attention, among other things, with mathematics and science (*Astr. Nach.* Bd. 135, No 3235); he graduated in 1866, the subject of his dissertation being the Comet III. of 1860. In the following year he entered in the Central-bureau der Mitteleuropäischen Gradmessung, and two years later in the Königliche Preussische Geodätische Institut, in which he commenced his great activity, which he continued up to the end. From July 1877 he conducted the sections relating to Geodesy.

Among the numerous valuable works brought before the public will be remembered the "Rheinische Dreiecksnetz," in which were a great number of Fischer's measurements, made at the majority of the stations employed. He found occasion also to busy himself with lateral refraction, and he made an interesting contribution on "Lothabweichungen in der Umgebung von Berlin" (1889), which was valuable in the discussion regarding the relation between Geodesy and Geology.

At a somewhat earlier date, in an article that appeared in the *Astr. Nach.* (Bd. 88), entitled "Die Gestalt der Erde und die Pendelmessungen," he brought forward the interesting deduction that the variation, which Ph. Fischer had calculated from the measures of gravity, could be traced back to geological causes, a deduction which agrees very nearly with our present ideas.

The publication of the "Berliner Basisnetzes" (1891) absorbed a great amount of his activity, as he paid special attention to this piece of work. In the measurements made in the Strehlen, Berlin, and Bonn base-lines operations, he took, finally in the capacity of director, a prominent part. We have to thank him, also, for some important thermoelectrical researches on the expansion of the rods used for base-line determinations. (*Astr. Nach.* Bd. 103.) He determined, also, the difference of longitude between Wangeroog and Schillig by means of optical signals, during the time of the operations on the trigonometrical survey of the North Sea islands and the mainland, with the computation of which he busied himself.

We are indebted to him for a great number of astronomical observations made at several stations for the trigonometrical work in which he was employed.

In order to get some idea of his dexterity and care, and more especially of his love for work and his self-sacrifice, one must not only look at the literary side of Fischer's activity, but at that in which his capacity as an observer was a very prominent feature.

Besides a host of numerous friends who mourn his loss, he leaves behind a widow and three children.

NOTES.

THE subjects for 1895 for the results of original research, upon which the Royal Society of New South Wales offer their medal and £25, are as follows:—(1) On the Silver Ore Deposits of New South Wales. (2) On the Physiological Action of the Poison of any Australian Snake, Spider, or Tick. (3) On the Chemistry of the Australian Gums and Resins. The communications are to be sent in not later than May 1, 1895. The subjects for 1896 are also announced as follows:—(1) On the Origin of Multiple Hydatids in Man. (2) On the Occurrence of Precious Stones in New South Wales, with a description of the deposits in which they are found. (3) On the Effect of the Australian Climate on the Physical Development of the Australian-born Population. The Society emphasise the condition that the award will not be made for a mere compilation, however meritorious it may be.

THE Council of the Royal Society of New South Wales have awarded the prize given by the Hon. Ralph Abercrombie for the best essay on "Southerly Busters" on the east coast of Australia, to Mr. Henry A. Hunt, second meteorological assistant in the observatory at Sydney. The essay contains the results obtained from a study of all the busters that visited the east coast from 1863 to 1893, and is illustrated by weather charts, cloud photographs, and diagrams showing the monthly and hourly distribution of these wind storms, as well as diagrams showing instrumental conditions in typical cases.

MANUSCRIPTS competing for the De Candolle Prize for 1895, offered by the Geneva Physical and Natural History Society, for the best unpublished monograph of a genus or family of plants, must be sent in by January 15, 1895. They may be written in Latin, French, German, English, or Italian. The value of the prize is 500 francs.

LIVERPOOL is fortunate in having citizens who testify their interest in the scientific welfare of the city by munificent generosity. We have previously noted the endowments, by the Earl of Derby and Mr. George Holt, of chairs in anatomy and pathology at the University College, Liverpool. We now learn, from the *British Medical Journal*, that the Rev. S. A. Thompson Yates has presented the College with the sum of £15,000 in order to build physiological and pathological laboratories.

THE Danish Government has undertaken, during the years 1895 and 1896, a deep-sea exploration in the Greenland and Icelandic waters. The expedition will be accompanied by a botanist.

ONE of the last acts of the late President Carnot, a few hours before his assassination, was to confer on the well-known botanist Dr. Saint-Lager the dignity of Officer of Public Instruction.

DR. V. SCHIFFNER has sent to the Botanical Institute of the German University of Prag a very large collection of dried plants and spirit-material from Western Java. He is intending also to visit Eastern Java and Sumatra.

THE antiquities, ranging from prehistoric down to Roman times, lately discovered by Prof. Flinders Petrie in the temple of Koptos in Upper Egypt, will be exhibited to the public in

the Edwards Library, University College, Gower Street, from July 23 to September 1.

THE death is announced of Dr. Adolph Hannover, at Copenhagen, at eighty years of age, and of Dr. J. Hyrtl, of Vienna University, at the age of eighty-four.

THE first annual meeting of the Australasian Institute of Mining Engineers, recently held at Ballarat, Victoria, appears to have been a very successful one. The inaugural meeting of the Institute was held last year at Adelaide, when Sir Henry Ayres, the President of the Legislative Council of South Australia, was chosen as its first president. Among the speeches delivered at that time was a very pointed one by the Hon. James Martin, the head of the engineering firm bearing that name. In the course of his remarks he said: "Science is much needed in mining, for without it mining cannot go along. We have been blundering too much by rule of thumb, which has done much to injure the mining industry and those who are willing to take some risks in mining. It has been the want of knowledge of the men who have been placed as mining managers that has ruined so many concerns. We want to bring science, experience, and knowledge to bear upon mining, so that we will be able to bring wealth from the earth without a waste of labour." Mr. James Stirling, the present president of the Institute, took the "Mineral Wealth of the Colony of Victoria" as the subject of his address at the Ballarat meeting. A variety of papers on mining topics were read and discussed, and visits were made to a number of mines and engineering works. The Institute has accepted an invitation from the Premier of Tasmania to hold the annual meeting in Hobart, Tasmania, next year, at which time the mining exhibition will be open.

UNDER the conductorship of Major Lamorock Flower, a meeting of the Essex Field Club was held last Saturday on the River Lea, the Conservancy Board having placed their steam-barge at the disposal of the club for the occasion. About sixty members embarked at Hertford and steamed down the river as far as Tottenham. Many well-known scientific men were present and gave addresses during the course of the day. Major Flower, after welcoming the party on behalf of the Conservancy Board (to which he is sanitary engineer), gave an account of the river and of his own work in connection with the improvement in its condition. After lunch at Broxbourne, Mr. J. E. Harting read a short paper on Izaak Walton's association with the river, and exhibited a most interesting set of prints in illustration of his remarks. Mr. G. J. Symons, F.R.S., later in the day, gave an account of the watershed, and explained the connection between the rainfall and the water supplied to the river. Mr. Howard Saunders followed with an address on the birds of the Lea Valley, and Mr. T. V. Holmes concluded with a paper on the geology of the district, explaining how the river had in the course of time shifted its bed generally in an easterly direction, leaving gravel deposits to the west often a mile or more from the present stream. As the result of a most enjoyable meeting, it was generally conceded that the river above the intake of the East London Waterworks Company at Ponder's End was in a very good condition, but great regret was expressed at the accumulation of heaps of the most evil-smelling garbage which here and there greeted the party on their way down. This refuse, as Major Flower explained, is brought from London in barges, and is heaped by the river banks under certain legal powers permitted by an Act of Parliament passed in 1868, and which the Conservancy Board has therefore at present no power of preventing; but it is to be hoped that the general advance of sanitary science will soon be such that public opinion will lead to legal restrictions as to the placing of decomposing refuse on the banks of any stream of which the water is used for human consumption.

ACCORDING to press telegrams, the cholera epidemic which has recently appeared at St. Petersburg is assuming an alarming character, being much more severe than that of last year. It is officially reported that 875 cases of cholera, and 294 deaths have occurred in St. Petersburg alone from the 8th inst. up to Saturday last. In Cronstadt, also, the disease has become epidemic, and other parts of Russia are seriously affected. A number of deaths from cholera are reported from the province of Galicia, in Austria-Hungary. Zaleszczki, in Galicia, has been declared to be a centre of the epidemic, and the necessary precautions have been taken to prevent communication with the infected district. Cases of cholera have also occurred in Sparta, near Adalia, Asia Minor, in the Prussian part of the Vistula, and at Liège and several surrounding villages, and an isolated case with choleraic symptoms has been notified at Paris.

FURTHER particulars with regard to the earthquake in Turkey last week show that it was of a very serious nature. No official return of the real number of victims has yet been published, but Reuter reports that the death-roll in Stamboul alone is known to exceed two hundred. According to Press telegrams, the damage to property in Constantinople is estimated to amount to £T6,000,000. There is scarcely a street in that city which does not show signs of the destructive effects of the earthquake, many of the old Turkish houses in Stamboul and the suburbs having been completely wrecked. The Grand Bazaar suffered severely. The vaulted roof of the jewellers' arcade fell in, causing a scene of great panic and confusion. Reuter's telegrams state that, at Prinkipo, the Greek Orthodox Church and a large number of houses were destroyed or seriously damaged. On the island of Halki nearly all the houses have been rendered uninhabitable. A portion of the Great Ottoman Naval College also collapsed, six students being killed and several injured. On the island of Antigoni not a house has been left intact, with the exception of the monasteries. At Pera four houses fell in, and many were damaged, the number of victims being five. The village of Galateria, near St. Stephano, has been completely destroyed. The shock was felt in the interior of Anatolia at a distance of 236 miles from Constantinople. Nearly all the railway stations have been damaged, and the town of Jalova, in the Gulf of Ismidt, has been almost totally destroyed. During the first shock at the island of Halki and the village of St. Stephano the sea retired over 200 yards, leaving many boats and vessels high and dry. The waters then returned with such force and violence that they overflowed the quay, hurling the boats on to the shore far above sea-level, and causing great damage. It is reported that shocks continue to be felt at intervals, but the movements of the ground are barely perceptible. The point from which the surface disturbances proceeded is said to be in the Sea of Marmora, somewhere between Jolava on the Asiatic side, and Stephano on the European side.

A PRIVATE telegram to the Royal Geographical Society has brought bad news of the Wellman polar expedition, the departure of which for Spitzbergen was noticed in NATURE, vol. l. p. 57. The steam-yacht *Saide*, belonging to Captain Townley-Parker, of the Royal Yacht Squadron, called at Danes Island, in the north-east of Spitzbergen, on July 6, and found the geologist of Mr. Wellman's party, Mr. Oyen, alone in charge of the house and stores. The expedition had reached Danes Island safely on May 7, and after landing Mr. Oyen, set out for Seven Islands on the 10th, promising to send back the steamer for Mr. Oyen in a week's time; but she had never returned. The *Saide* at once attempted to go in search of the missing vessel, but was stopped by ice off Hakluyts Head in 80° 10′ N., and compelled to return. No trace of the ship had been seen by the Norwegian walrus-hunters who are cruising off Spitzbergen, and the inevit-

able conclusion is that she has been beset by the ice and probably foundered. It is hoped that Mr. Wellman and his party of fifteen men had left the vessel and started on their northward journey before this happened; and if that be so, there is no reason why they should not return safely to Danes Island. Spitzbergen is now visited so frequently during the summer months, that little anxiety need be felt as to their return to civilisation should they be able to regain the island; but since the provisions in store are only sufficient to supply eight men for six months, it is important that additional supplies should be sent to provide for emergencies.

WE have received from Prof. Guido Cora a copy of a short paper communicated by him to the Italian Geographical Congress of 1892, in which he strongly urges the importance of a more complete and detailed study of the minute geography of Italy, proposing the formation of a special committee to elaborate and carry out the scheme. It is a subject no less pressing in England than in Italy, for to a properly qualified geographer there is no part of the world riper for investigation and more deserving of study than those countries of Europe in which the ground for a solid constructive geography has been laid by complete topographical and geological surveys.

THE State of Minas Geraes in Brazil has recently established a Geographical and Geological Commission, entrusted with the rectification of the topographical map and with the geological survey of the State. The first *Boletim* of this Commission has just been published at Rio de Janeiro by Señor A. de Abreu Lacerda, chief engineer. It contains an account of the objects of the Commission, which are to delimit the State and lay down the boundaries of the subordinate political divisions, to determine the nature of the rocks, minerals, and cultivable soils, to fix the altitudes of important places, and to make a triangulation of the State. The work is modelled on that of the United States Coast and Geodetic and Geological Surveys, and there are several Americans engaged on the operations.

THE lectures to intending travellers on various aspects of science, given at the Natural History Museum in Paris, continue, and are reported fully in the *Revue Scientifique*. The most recent were on Palæontology, by M. Marcellin Boule, and on "Metrophotography" by M. Laussedat. The latter is particularly interesting, and shows that the use of photography in surveying is a natural development of a method which Beautemps-Beaupré introduced more than fifty years ago. He utilised panoramas sketched by means of a camera lucida at opposite ends of a measured base-line, and by an ingenious arrangement of the two views on a plane-table plotted the map without any calculations. In this method photography simply facilitates the production of the pictures, the rest of the process remaining the same. The calculation of vertical heights from the photographs is simple when the correct relative distances of the objects are laid down on a map, and thus the simple operation of taking a photograph of the same object from two points suffices for the construction at any future time of a contoured map.

FROM a circular receivad from Prof. Dr. Coloman Müller, we note that the preliminary arrangements of the Eighth International Congress of Hygiene and Demography, to be held at Budapest from September 1 to 9, 1894, are nearly completed. The Congress promises not only to be a worthy successor of its predecessors, but also to be in some respects superior to them. Up to the present time a total of 725 papers have been notified, of which 593 belong to the Hygienic, and 132 to the Demographic groups of the Congress. Besides this, 26 Governments with 92 delegates, 91 Public Corporations with 163 delegates, 41 Universities with 65 delegates, and last, but not least, 132 learned Societies with 300 delegates, have expressed their intention of being represented at the Congress. The following are among the subjects of promised communications:—Mr. Ernest Hart, on protection against cholera in the Orient, and the hypothesis of its epidemic diffusion; Prof. Dr. E. Leyden (Berlin), on provisions made by large towns for consumptives; Prof. Dr. George Mayr (Strassburg), on statistics and social science; Baurath Herzberg, C.E. (Berlin), the civil engineer's work in hygiene; Prof. E. Levasseur (Paris), the history of Demography; Prof. Dr. E. T. Erisman (Moscow), the struggle with death; Prof. Dr. C. Lombroso (Turin), the criminal.

THE Congress of the British Institute of Public Health, to be held in London from July 25 to 31, under the presidency of Prof. W. R. Smith, promises to be an important one. About 1500 delegates have already been appointed, and if two-thirds of the number attend the meetings the organisers at King's College will have a difficulty in accommodating them. The Congress will be divided into five sections as follows:—(A) Preventive Medicine; (B) Chemistry and Climatology; (C) Municipal and Parliamentary; (D) Engineering and Building Construction; (E) Naval and Military Hygiene. Among the subjects which will be brought up for discussion in the first section are:—The mode of spread and methods of prevention of diphtheria; the dissemination of disease by river-water; the self-purification of rivers; and the alleged aërial diffusion of smallpox. In the second section the subjects for discussion include the chemical and bacteriological examination of water; the purification of sewage; and the micro-organisms in sewer air. In Section D discussions have been arranged on electric lighting from the point of view of public health; on a system of softening public water supplies; sewage disposal; and other matters. There will be conferences on "The Housing of the Working Classes" and "The Provision of Isolation Hospitals," and on Saturday, the 28th inst., Prof. E. M. Crookshank will deliver a popular lecture on "Microbes and the Spread of Infectious Diseases." A number of visits will be made to places and institutions of interest from a public health point of view.

IN a memorandum on the mitigation and prevention of insect ravages in India, forwarded a short time ago to the Department of Revenue and Agriculture of the Government of India, the Hon. J. Buckingham, C.I.E., pointed out the necessity for a staff of entomologists, and suggested a scheme for the organisation of an entomological department. Though crops to the value of millions of rupees are destroyed annually in India by insect pests, the Government had not until recently seriously set to work to modify these ravages. In the United States, as also in Canada and parts of Australia, the Government has taken up the matter, with the result of the introduction of new methods of treatment which in some cases have effected an enormous saving. The memorandum calls attention to the fact that in the United States, besides entomological advisers attached to individual States, a strong section of entomology is kept up as a branch of the Agricultural Department of the Central Government. Attached to the entomological section are some fourteen trained entomologists, who visit all parts of the country in order to study and report upon destructive insects. The great importance of collecting information personally upon the spot is so fully recognised that the travels of the investigators are not confined to the limits of the United States, but representatives are even occasionally despatched to distant parts of the world. At the time when the memorandum was drawn up, however, all that had been done was to empower one of the officers of the Indian Museum in Calcutta to report upon insects which were submitted by planters, officials, and others, and to publish the results. Doubtless in this way a considerable amount of

information has been collected, and the nature of a large number of the more destructive species of blights have been ascertained; but, as the memorandum urged, what was wanted was a specialist free to move about the country, and supported by laboratory assistants in some fixed place. To render the work of practical value, it is essential that it should be carried on continuously from year to year, so that the observations made in one season may be supplemented and verified by those made in the next, and that a record may be kept up of the increase or decrease of particular blights, so that the planting and agricultural community may be warned in time of impending danger. For the sake of Indian agriculture, we are glad to see that the scheme put forward by the Hon. J. Buckingham has been favourably considered. The Government of India has expressed a readiness to appoint two or three entomologists for the benefit of agriculturists throughout the country. It is not, of course, supposed that the appointment of this small staff of entomologists will result in the suppression of every destructive insect; but there can be no doubt that careful local investigations would, in many cases, lead to the development of improved methods of fighting the evil. In connection with the subject of the memorandum, it is worth remark that the Planters' Association of Ceylon have recently made the modest request for one entomologist to study the insects which attack tea and other plants under cultivation there. Dr. Trimen, of the Royal Botanic Gardens, Peradeniya, has, however, informed the Colonial Secretary at Colombo that, while he would support the appointment of an entomological assistant for the Colombo Museum, who would pay special attention to injurious insects, he could not recommend the appointment of an entomologist for the agricultural community alone. Mr. A. Haly, the Director of the Museum, also thinks that a special officer is not needed for the small area covered by Ceylon, and suggests that the case would be fully met by the appointment of an entomological referee.

THE *Illini* informs us of the establishment on the Illinois River, at Havana, of a biological station devoted to the systematic and continuous investigation of the plant and animal life of the waters of that region. This establishment, authorised by the trustees of the University in March, is under the direction of Prof. S. A. Forbes, with Mr. Frank Smith in immediate charge of the work. The field work is done from a cabin boat, chartered for the summer, which carries the seines, dredges, surface nets, plankton apparatus, and other collecting equipment, together with microscopes, reagents for the preservation of specimens, a small working library, a number of special breeding cages for aquatic insects, and a few aquaria. This boat is provided with sleeping accommodation for four men, and with a well-furnished kitchen. In Havana itself are office and laboratory rooms supplied with running water and electric light, and provided with the usual equipment of a biological laboratory, consisting of first-class microscopes, microtomes, biological reagents, &c., and tables for five assistants. The boat is established in Quiver Lake, an elongated bay of the Illinois, two and a half miles above Havana. From the lake and the river, selection has been made of a number of typical situations, and from these, and from Phelps and Thompson lakes, a little distance away, collections of all descriptions are made at regular intervals for a comparative study of the organic life—the relative abundance of the species at different seasons of the year, and the general system of conditions by which it is affected. We understand that this is the first inland aquatic biological station in America manned and equipped for continuous investigation; and the first in the world to undertake the serious study of the biology of a river system.

WE learn from the *Lancet* that an admirably appointed biological station, modelled upon that at Naples, has just been opened at Dröbatt, on the Christiania Fiord, not far from Christiania. It is said that the international element so wisely encouraged in the Neapolitan institution, by which, in return for an annual subsidy, the universities of the world are entitled to avail themselves of its facilities, will also be recognised at the Norwegian station.

THE report for 1893 of Dr. S. Schönland, the Curator of the Albany Museum, Grahamstown, to the Committee of the museum, has been issued. We learn from it that the institution has largely increased in popularity, the number of visitors having been over 22,000, or more than 2000 in excess of those of 1892. Its value as an educational institution has also been widely appreciated. The Committee dwells on the necessity of the appointment of an assistant who would take over the Entomological Department, the work having become too great for the Curator. It is also urged that, as the grant hitherto accorded to the institution by Parliament is insufficient, even with the greatest economy, to meet urgent requirements, a suitable increase will be made. As many as 7660 specimens were added to the collection in the museum during 1893, all of them being of South African origin.

THE changes of plumage in the Red Grouse (*Lagopus mutus*) have long attracted the attention of ornithologists. Mr. W. R. Ogilvie-Grant gives, in *The Annals of Scottish Natural History* for July, an interesting account of these changes, the nature of which he has described in vol. xxii. of the Catalogue of the birds in the British Museum. In that publication it was conclusively shown that both the male and female of the Red Grouse have two distinct moults during the year, but whereas in the male they occur in autumn and winter, in the female they take place in spring and autumn; the former having no distinct spring, and the latter no distinct winter, plumage. These seasonal variations are clearly explained in the paper referred to, and the principal changes, moults, and varieties are illustrated in two beautifully coloured plates, the feathers of each sex being shown separately.

DR. R. HANITSCH, of Liverpool, has done a most useful and, we need scarcely say, laborious piece of work in his revision of the generic nomenclature and classification in Bowerbank's "British Spongiadæ" (Trans. Liv. Biol. Soc., viii. 1894, pp. 173–206). His paper consists of two parts, dealing with the nomenclature and classification respectively. In the first section are given parallel columns of Bowerbank's and the revised nomenclature; and in the second a list of the British sponges described by Bowerbank, classified in accordance with recent research. Definitions of all British genera of Monaxonida are given. *Lissomyxilla*, for the reception of Bowerbank's *Tethea spinosa*, is new. For the most part, however, the author's arrangement is compiled from the revisions and work of Ridley and Dendy, Sollas, Topsent, Von Lendenfeld and Vosmaer.

A NEW form of phonograph of a particularly simple construction has been described before the Electro-chemical Society of Berlin by Herr A. Kœltzow. In this instrument, which in consideration of its low price appears suited to many purposes, at any rate in those countries where patent rights will not prevent its introduction, the cylinder on which the record is made is composed of a hard kind of soap. Each cylinder, which costs about three shillings, admits of being used for recording 250,000 words, since an arrangement allows of the removal of a very thin layer from the surface when this has been covered. Thus the cost of the cylinders for registering any number of words is not more than the cost of the paper which would be required if they were written down.

THE village of Gossau, situated about ten kilometres from St. Gall in Switzerland, was recently the scene of a curious electrical phenomenon. This village is lighted by a supply station situated at a distance of twelve kilometres, which supplies the current at high tension to transformers at the village. During a thunderstorm, which lasted several hours, the supply wires were struck by lightning, all the electric lamps being extinguished, while bright sparks passing between the aërial wires lighted up the whole village. These phenomena were particularly brilliant at the chief transformer sub-station, where the sparks continued to pass for more than an hour, and only stopped when the circuit was broken at the generator station.

THE current number of *Science Progress* contains a paper by Mr. Chree, the Superintendent of the Kew Observatory. In this paper, which is entitled "The most recent Values of the Magnetic Elements at the Principal Magnetic Observatories of the World," the author points out the importance of the continuous records of the different magnetic elements made at some of the observatories, both for the purpose of applying the correction for secular change to the charts and maps used by travellers by land and sea, and for allowing observers engaged on a magnetic survey to correct their observed results by allowing for any disturbance of the observed element from its mean value at the moment at which the observation was made. The possibility of making this correction depends on the fact that the diurnal change as well as the small irregular disturbances occur simultaneously, and similarly over considerable tracts of country. This fact is very markedly shown by superposing the photographic traces obtained at Kew and Falmouth, when it will be found that every little undulation is faithfully reproduced. The paper also contains a "popular" account of the different observations made, and the methods by which the photographic curves are obtained and the results reduced. A most useful table of the magnetic elements at the different observatories, which we see from an editorial note is to be continued from year to year, is appended. This table contains besides the latitude and longitude of the observatory, the mean declination, dip, horizontal force and vertical force for the last year for which data are available. A very useful addition to the table would be four additional columns giving, where possible, the secular change.

WE have received from T. Homén, of the University of Helsingfors, a work entitled *Bodenphysikalische und meteorologische Beobachtungen*, which has been carefully compiled from all available sources, and also from a long series of observations made by the author, with especial reference to night frosts and their effect upon vegetation in the spring and autumn. The observations and conclusions refer more particularly to northern Europe, but will be found of practical use to agriculturists generally. The work is divided into six sections; the first three deal with the temperature and the conductivity of the earth's surface, and at various depths, with different kinds of soil, with the formation of dew, and with evaporation, while the last three chapters deal with the phenomena of night frosts, the methods of their prediction, and a discussion of the various means which may be adopted to prevent or lessen their injury to vegetation. The chapter relating to the conditions under which frosts usually occur is instructive, and shows that they chiefly depend upon the tracks taken by barometric depressions, the positions of areas of high barometer, and on the amount of the radiation from the surface of the earth. The method sometimes adopted of predicting frost from the position of the dew-point in the evening is shown to be very unsafe, especially for ground temperatures. The protection caused by burning wet straw or moss, and so preventing radiation by means of smoke, is fully discussed; but the plan is not likely to come into general use, owing to the large area over which fires have to be lighted, and the probability of the smoke being drifted away by currents of air. The experiments have been made at a considerable cost of labour and money, part of the necessary funds having been contributed by the authorities of the University.

A PAPER on the "Geology of Torres Straits," from the combined points of view of Profs. A. C. Haddon, W. J. Sollas, F.R.S., and G. A. J. Cole, was read before the Royal Irish Academy two years ago, and has just been published in the Society's *Transactions* (vol. xxx. part XI.). This is the first time that any detailed description has been given of the islands between Queensland and New Guinea. One of the chief conclusions arrived at, from a close study, is that no recent movements of elevation of the shores of Torres Straits have taken place. "As our knowledge grows" (the authors state) "we the more distinctly see in Australia and its islands the ruins of a great southern continent, fractured and submerged, possibly during the great Alpine Himalayan revolutions, and now in process of resurgence, as the vast folds of the earth's crust roll slowly inwards upon the central continental mass."

A COPY of Dr. Sykes' report on the cause of the increase of mortality from diphtheria in London, prepared at the instance of the Health Department of the Vestry of St. Pancras, has been sent to us. Dr. Thorne Thorne, who has also drawn up a report on the same subject, concludes that increased school attendance has had a material influence in increasing the spread of diphtheria, and Dr. Sykes regards this conclusion as irresistible. Again, the increase in cases described as diphtheritic may be also due to variation in nomenclature, most forms of infectious sore-throat being now regarded as diphtheria, whereas formerly the term was restricted to typical cases. Dr. Sykes is, however, also of opinion that the variation in nomenclature may very possibly be due to a change of type in disease of the throat, brought about by increased density of population in our great towns, and the effects of increased personal infection consequent upon the greater aggregation in schools. But does this explain why London should be singled out from all our great cities for such a disastrous epidemic of diphtheria as has unfortunately prevailed over such a long and continuous period? Why should not these causes apply with equal force to Glasgow, Manchester, Birmingham, or any of our great centres of industry?

FRANK, and afterwards Schloesing and Laurent, showed that soil containing bacteria and algæ can fix free nitrogen in large quantities; their experiments, however, did not decide whether algæ alone are capable of doing this. In order to answer this question Kossowitsch has estimated (*Botanische Zeitung*, May 16, 1894) the amount of nitrogen present in a nutritive soil before and after the growth of pure cultures of two kinds of algæ, *Cystococcus* and *Stichococcus*. In neither case was any sensible increase of nitrogen detected; so that it appears that neither of these algæ alone have the power of fixing free nitrogen. *Cystococcus*, even when mixed with pure cultures of the bacteria which enable the Leguminosæ to assimilate free nitrogen, was found powerless in this direction; whereas a mixture of soil-bacteria and *Cystococcus*, which also contained a small amount of other algæ, had the power of fixing free nitrogen to a large extent. The same author also describes a number of experiments with heterogeneous mixtures of algæ and bacteria, and shows how in each case the capability of fixing free nitrogen is greatly increased by the addition of dextrose to the nutritive substratum. From this and also from the fact that such mixtures of algæ and bacteria which are capable of fixing free nitrogen when exposed to light cannot be shown to assimilate it in the dark, he concludes that although in no case has it been proved

that algæ by themselves possess the power of fixing free nitrogen, yet they are in a symbiotic relationship with the nitrogen-fixing bacteria, and he regards it as probable that these latter draw on the assimilation-products of the algæ to supply the carbon they require in growth.

MR. BERNARD QUARITCH, Piccadilly, has issued a new list (No. 143) of the old and valuable books he has for sale. The list contains a number of rare books of travel, and many important works on botany, entomology, and ornithology.

MESSRS. HENRY SOTHERAN AND CO. will shortly issue a second and cheaper edition of Mr. J. G. Millais' "Game Birds, and Shooting Sketches," with illustrations by the author, and a frontispiece by Sir J. E. Millais, Bart.

WE have received a copy of "Bourne's Handy Assurance Manual" for 1894, now edited by Mr. William Schooling. The volume differs from its predecessors in several important respects, and some of the tables in it may be found useful to students of demography.

THE first volume of "The Royal Natural History," edited by Mr. Richard Lydekker, F.R.S., has been published by Messrs. Frederick Warne and Co. It is illustrated with numerous coloured plates and engravings, and forms a desirable addition to any library. We look forward with pleasure to the publication of the remaining volumes of Mr. Lydekker's important work, a work that possesses scientific interest and has a high educational value.

THE frontispiece of the July number of the *Monist* is a portrait of the late Dr. Romanes. Accompanying it and a short obituary notice, are two stanzas from a memorial poem addressed by the deceased investigator to Charles Darwin, and embodied in a volume printed for private circulation. The number also contains, among other matter, a paper entitled "The Non-Euclidean Geometry Inevitable," by Prof. G. B. Halsted; one on "Leonardo da Vinci as a Pioneer in Science," by Mr. W. R. Thayer; and another on "Monism in Arithmetic," by Prof. Hermann Schubert.

IN the *Journal of Botany* for July is "A Tentative List of British *Hieracia*," which affords a remarkable instance of the tendency to "splitting" displayed by botanists who devote themselves to monographing genera or families. Hooker's "Student's Flora" enumerates 10 British species of *Hieracium*, the eighth edition of Babington's "Manual" 33. The present list comprises no less than 103 specific names, besides varieties. Of these species 36 are attributed to two English botanists who have made the genus their special study, Mr. W. R. Linton and Mr. F. J. Hanbury.

As in previous years, the *Photographic Annual* for 1894, edited by Mr. Henry Sturmey, contains a number of excellent pictures illustrating various systems of photographic and photo-mechanical reproduction. Some of these illustrations are extremely fine. We are specially interested in four figures reproduced from photographs of microscopic objects, obtained by Mr. Frederick Iles in a novel manner. By a method of stereoscopic illumination, not described, he has procured "stereomicrographs" showing objects in beautiful relief, and which greatly disparage pictures obtained with ordinary illumination. Plant sections, medical sections, crystals, and other translucent objects are found by Mr. Iles to furnish good results. Judging from the photographs reproduced, the method may have important scientific applications. The text of the *Annual* includes records of the progress, during 1893, of photographic chemistry, by Mr. C. H. Bothamley; photographic optics, by Mr. Chapman Jones; and an admirable summary of work in astronomical photography, by Mr. Albert Taylor. The *Annual* also contains the usual complement of articles on practical photography, and information on recent novelties in photographic apparatus, appliances, and processes.

THE first edition of the late Sir Andrew Ramsay's well-known "Physical Geology and Geography of Great Britain" (Edward Stanford) appeared in 1863. Between then and 1878 five editions of the work were issued, and a sixth has just been published. This edition has been prepared by Mr. H. B. Woodward, and his "restoration" has been admirably done. It is a difficult task to enter thoroughly into the spirit in which an investigator like the late renowned geologist indites a book, but Mr. Woodward has allowed his personality to merge into that of the lamented author, and the result is that the work begins a new life in all its original freshness and vigour. More than thirty years ago, Sir Andrew delivered the lectures out of which the book has grown. The object of the course was "to show how simple the geological structure of Great Britain is in its larger features, and how easily that structure may be explained to, and understood by, persons who are not practised geologists." Some of the author's theoretical views have been called into question, but others have served to establish his perspicuity on geological matters. Throughout the book, however, controversial subjects are fairly treated in the light of latter-day evidence. The part in which the greatest changes have been necessary is that referring to Archæan rocks. Considerable changes had to be made in order to bring this section of the book into touch with current opinion. Not only have such necessary emendations been made, but most of the more or less uninteresting details inserted in the fifth edition have been omitted or condensed. Where the author's theories have been entirely controverted, the accepted views have been substituted for them, but opinions still *sub judice* have been left in their original form. Several changes have been made in the excellent little geological map which forms the frontispiece, especially in the northern part of Scotland. All the revision has been in the direction of improvement, and we have no doubt that numerous readers will appreciate the careful manner in which it has been done.

THE additions to the Zoological Society's Gardens during the past week include two Lesser White-nosed Monkeys (*Cercopithecus petaurista*, ♂ ♀), a Campbell's Monkey (*Cercopithecus campbelli*, ♀), a Brush-tailed Porcupine (*Atherura africana*) from West Africa, presented by Mr. W. H. Boyle; a Mona Monkey (*Cercopithecus mona*, ♂) from West Africa, presented by Mr. Charles Gardiner; two —— Tortoises (*Testudo*, sp. inc.) from the Aldabra Island, presented by Rear-Admiral W. R. Kennedy; a Crowned Lemur (*Lemur coronatus*, ♀) from Madagascar, deposited; an Eland (*Oreas canna*, ♂) from South Africa, a Livingston's Eland (*Oreas canna livingstonii*, ♀) from the Transvaal, two Short-toed Hedgehogs (*Erinaceus brachydactylus*) from Somaliland, purchased; a Thar (*Capra jemlaica*), a Japanese Deer (*Cervus sika*, ♀), a Wapiti Deer (*Cervus canadensis*, ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

VARIATIONS OF LATITUDE.—Since 1885, the fifteen polar stars of which the apparent places are given in the *Connaissance des Temps*, have been regularly observed at Lyons Observatory. The materials thus obtained are used by M. F. Gonnessiat, in the *Bulletin Astronomique* (vol. xi. June and July 1894), for an investigation of the variations of latitude. The calculations show that from one maximum to the next the mean interval is 1·185 years; while the mean interval between

two successive minima comes out as 1·178 years. In round numbers, therefore, the variation has a period of 1·18 years, that is, 431 days, which agrees with that found by Mr. Chandler. The mean amplitude of the oscillation is 0″·44. As to the annual variation, M. Gonnessiat is inclined to think that it has no real existence. He points out that one batch of observations discussed by Mr. Chandler, was like those made at Lyons, and hence refraction and errors of delineation introduce apparent annual changes in the results. In the case of observations made in the prime vertical by Horrebow's method, it is argued that refraction would show itself in the results, not only by its effects on the zenith distance of the same star in the course of a year, but also on the same day, when the connection between the groups observed is established. It is further remarked that the intensity of gravity, which determines the phase of the annual term, is far from being constant at any single place, and that its variation with the longitude does not appear to have been established. For these reasons M. Gonnessiat holds that it is necessary to exercise "une certaine réserve à l'égard du second terme de la formule de M. Chandler."

PHOTOGRAPHS OF THE MOON.—At the meeting of the Paris Academy of Sciences on July 9, MM. Lœwy and Puiseux exhibited some marvellous photographs of the moon, obtained by means of the great *coudé* equatorial of the Paris Observatory. In the communication which accompanied the photographs, the advantages of multiplying good lunar photographs were pointed out, and the various methods employed in the work were passed in review. One of the enlargements on paper, shown to the Academy, represented the moon on a scale of 1·80 metres for its diameter, and five lunar pictures on glass were exhibited at the same time. Some years would be required to make a drawing showing all the details visible on one of the plates obtained with an exposure of about a second. The negatives are larger than those obtained with the Lick telescope, and they bear considerable magnification without loss of definition. But such negatives cannot always be obtained. MM. Lœwy and Puiseux say that, of fifty or sixty evenings employed in lunar photography, only four or five gave really first-class results. A complete series of negatives, tracing the moon through its phases, has not yet been obtained at Paris, but what has been done has furnished material for experiments in making enlargements. This part of the work is really as important as that of taking the negatives. From the results, MM. Lœwy and Puiseux conclude that a complete lunar atlas of the dimensions proposed by Prof. S. P. Langley can be made by means of the great *coudé* telescope at the Paris Observatory without the expenditure of much time and work. A comparison of the enlargements with previous representations of the same regions shows that real progress has been made. Another great step in advance will have been made when all the phases of the moon have been reproduced photographically in pictures so clearly defined as those just obtained.

FURTHER CONCERNING THE NEW IODINE BASES.

A FURTHER contribution to the chemistry of their recently discovered iodonium bases, by Prof. Victor Meyer and Dr. Hartmann, will be found in the present issue of the *Berichte*. In their two former communications, an account of which will found in NATURE, vol. xlix. pp. 442 and 467, in addition to the free parent base $(C_6H_5)_2I.OH$, descriptions were given of the iodide $(C_6H_5)_2I.I$, the chloride $(C_6H_5)_2I.Cl$, the bromide $(C_6H_5)_2I.Br$, and the pyrochromate $[(C_6H_5)_2I]_2Cr_2O_7$. Several new salts are now described, most of which crystallise well, and several are endowed with properties of a particularly interesting character. The similarity to the salts of thallium becomes even more apparent as the reactions of the derivatives are elaborated. The hydroxide has already been shown to be an easily soluble and an alkaline substance; the carbonate is likewise soluble in water and exhibits an alkaline reaction, and the halogen compounds are similar in colour, solubility, and other physical properties to the corresponding thallium salts.

The *nitrate*, $(C_6H_5)_2I.NO_3$, is obtained as a white crystalline precipitate when a concentrated solution of the free base is neutralised with concentrated nitric acid. It is readily soluble in hot water, and crystallises on cooling in the form of small plates or under particular conditions of concentration in compact spear-like crystals. It melts at 153°–154° to a clear liquid which soon commences to decompose with evolution of gas. When larger quantities are heated they explode with some violence. The nitrate is also produced when the chloride is treated with fuming nitric acid; upon the addition of twice as much water and allowing the liquid to cool, well-formed crystals of the nitrate are deposited.

The *acid sulphate*, $(C_6H_5)_2I.HSO_4$, is produced in solution when a moderately concentrated solution of the base is feebly acidified with concentrated sulphuric acid. Upon evaporation to small bulk over a water-bath and allowing to cool the salt crystallises in compact aggregates. It is so largely soluble in water that it cannot be recrystallised from that liquid, and in order to free the salt from adhering sulphuric acid the crystals are dissolved in the minimum quantity of alcohol and a quantity of ether added, which precipitates the salt in clear colourless crystals. It reacts acid to litmus, and the crystals melt like those of the nitrate at 153°–154° to a clear liquid which decomposes at a higher temperature.

The *acetate*, $(C_6H_5)_2I.OC_2H_3O$, has been obtained under somewhat peculiar circumstances. It was shown in the previous communication that iodobenzene was attacked by caustic soda after agitation of the mixture for some little time, and that the solution, which contained the iodonium base, yielded a white precipitate with acetic acid. This precipitate consists of the impure acetate of the base. If the liquid is filtered immediately after the addition of the acetic acid, when it is quite warm (about 30°) owing to the heat of the reaction, the clear filtrate deposits crystals of the pure acetate, which melt with decomposition at 120°.

The *periodide*, $(C_6H_5)_2I.I.I_2$.—This interesting compound, analogous to the iodine addition products of the alkyl ammonium iodides, is obtained by mixing the iodide of the base with a little alcohol and triturating with an alcoholic solution of iodine. The combination occurs almost instantaneously with production of a brownish-red precipitate, which crystallises from alcohol in magnificent dark red, almost black, and exceptionally lustrous crystals which melt at 138°.

Double salts.—The chloride forms characteristic double salts with mercuric chloride, gold chloride, and platinic chloride. The mercuric chloride compound, $(C_6H_5)_2I.Cl.HgCl_2$, is obtained as a white precipitate upon the addition of corrosive sublimate solution to a solution of the chloride of the base. It crystallises from water in highly refractive colourless needles which melt at 172° with decomposition. The gold salt, $(C_6H_5)_2I.Cl.AuCl_3$, obtained by precipitation with gold chloride, crystallises from hot water in yellow needles melting at 134°–135° with decomposition. The platinochloride, $[(C_6H_5)_2I.Cl]_2PtCl_4$, is obtained by use of chloroplatinic acid as a flesh-coloured precipitate which is very difficultly soluble even in boiling water, and only crystallises from the solution in microscopic needles. Its melting point is 184°–185°, and decomposition occurs upon fusion.

Sulphides.—It was a point of considerable interest to ascertain whether the similarity of the iodonium bases to thallium would be carried as far as the formation of insoluble sulphides. This is indeed found to be the case, and the sulphides are in external appearance most remarkably similar to the freshly precipitated sulphides of lead, thallium, and antimony. When a solution of the free base is mixed with ammonium sulphide a bright orange-red precipitate, very similar to antimony sulphide, is produced. If the experiment is carried out with ice-cold solutions and the product is maintained at 0°, the precipitate is quite stable. If it is performed at the ordinary temperature, however, in a very short time the orange precipitate begins to hiss and seethe, white clouds of vapour are projected out of the liquid, and the solid precipitate rapidly changes to a mobile oil. Analyses and fractional distillations show that the solid orange precipitate is the trisulphide of the base

$$(C_6H_5)_2I.S.S.S.I(C_6H_5)_2,$$

and that this substance decomposes at the ordinary temperature into phenyltrisulphide and iodobenzene.

$$[(C_6H_5)_2I]_2S_3 = 2C_6H_5I + (C_6H_5)_2S_3.$$

The normal sulphide, $(C_6H_5)_2I.S.I(C_6H_5)_2$, has been obtained by the action of sodium sulphide, Na_2S, which precipitates it as a bright yellow precipitate. It rapidly changes at the ordinary temperature, in the same manner as the trisulphide,

to a colourless oil consisting of iodobenzene and ordinary phenyl sulphide.

$$[(C_6H_5)_2I]_2S = 2C_6H_5I + (C_6H_5)_2S.$$

Reduction of the free base is brought about by the action of sodium amalgam in the cold, a molecule of the base decomposing into benzene, water, and hydriodic acid, which latter precipitates a second molecule of the base as the insoluble iodide.

$$2(C_6H_5)_2I \cdot OH + 4H = (C_6H_5)_2I \cdot I + 2C_6H_6 + 2H_2O.$$

The solution of the free base precipitates solutions of the salts of the heavy metals exactly like ammonia or the fixed alkaline hydrates.

The physiological action of the chloride of the base has been studied in detail by Dr. Gottlieb, of the Heidelberg Pharmakologisches Institut. The salt has been found to be very poisonous, and its mode of action upon the animal muscles, membranes and nerves, combines the characteristics of the action of lead and thallium salts with those of ammonia and the ammonium bases.

A. E. TUTTON.

WOMEN AND SCIENCE.[1]

THIS little volume is to all intents and purposes a charming and eloquent appeal in support of the claims of women to effectual recognition in the scientific world. In reality it purposes only to give in brief outline the lives of half a dozen women who have rendered important service to mathematical science. But although brief the sketches are so clever that the various characters depicted could scarcely appear more living or real, whilst there is not a single dull sentence to be found in the book.

One of the most interesting of the short studies, because so closely connected with the present, is that of the gifted and fascinating Sophie Kowalevski, who only died three years ago, and who commenced her study of mathematics at the age of fourteen, and at eighteen married Kowalevski, "parce qu'il n'était permis qu'aux dames de suivre les Cours des Universités!" On the presentation of three original theses, the University of Göttingen hastened without further examination to confer the degree of Doctor of Philosophy upon her, and later in life she was appointed to a chair of mathematics in Stockholm. But Sophie Kowalevski was not only a gifted mathematician of whom Kronecker declared "l'histoire des mathématiques parlera comme d'une des plus rares investigatrices," but an accomplished *littérateure*, and the author of numerous books, one of which is entitled "Souvenirs sur George Eliot," whilst "Les Souvenirs d'enfance" is described as a fine bit of psychological study worthy of Tolstoi, or of the new "Immortal" Bourget.

The place of imagination in science, so forcibly insisted upon by Mr. Goschen some years ago in his rectorial address at Edinburgh, is beautifully put in a letter to a novelist friend astonished at her pursuing science and letters simultaneously. "People frequently regard mathematics as a dry and barren science. In reality the pursuit of mathematics demands a great deal of imagination, and one of the greatest mathematicians of our century said, with justice, that it is impossible to be a good mathematician without at the same time having a touch of the poet."

Some sixty or seventy years earlier we read of another highly gifted mathematician, Sophie Germain, who at the same time distinguished herself by her contributions to philosophy. M. Rebière tersely summarises her claims to distinction by thus closing his memoir: "Pour construire la tour Eiffel, les ingénieurs ont utilisé l'élasticité des métaux. On a inscrit sur la tour les noms de 72 savants; on a oublié celui d'une fille de génie, la théoricienne de l'élasticité!"

England is represented by Mrs. Somerville in a very bright and sympathetic little notice, whilst Italy sends her contribution in the shape of "la nobile fanciulla" Marie Agnesi, who Pope Benedict XIV. nominated Professor of Mathematics in the University of Bologna, writing—"It is not you who should thank us; on the contrary, it is we who owe all our thanks to you. From the most remote times Bologna has heard of people of your sex occupying its public chairs. It belongs to you to worthily perpetuate the tradition." In commenting upon this distinction M. Rebière cannot resist telling us of some of the numerous women who have at various times held professorial appointments at Bologna. The list is instructive, and we quote it in full, for we cannot afford to admit women as fellows of any of our learned societies even!—"In languages, philosophy, and theology: Priscopia Cornaro, 'maîtresse des arts libéraux'; Clotilde Tambroni, hellenist, who had Mezoffanti as a pupil. In law: Dotta, daughter of Accurse; Biltizia Gozzadini, in connection with whom a pamphlet was published, *De mulierum doctoratu*; the two sisters, Bettina and Novella Calendrini. It appears that Novella was so beautiful, that it was necessary, in order to avoid distracting the students, to draw a slight curtain between her and the audience. In natural science and medicine: Alexandra Gigliani, Maria Petraccini, Anna Manzolini, and Sybille Mérian. The latter, who was a German, went to study insects at Surinam; she published an important work, and left her collections to the School of Bologna. In physics and mathematics: Laure Bassi, who married Dr. Verati, and who whilst teaching physics during forty years was a model wife and mother; the two astronomers, Thérèse et Madeleine Manfredi, sisters of the Director of the Observatory, who published a volume entitled 'Astronomy for Women.'"

The bust of Marie Agnesi was subsequently placed by Cardinal Dumini in his gallery of distinguished Lombards, and on her tomb these words were inscribed: "Fille remarquable par sa piété, sa science et sa bienfaisance."

We are introduced to a very different woman and mathematician in the person of Madame la Marquise du Châtelet, the friend of Voltaire, and whom the Prince Royal of Prussia familiarly addressed as Vénus Newton!

M. Rebière tells us that she had preserved, in spite of her studies, "une certaine frivolité. Son goût pour la parure et les diamants était très vif. Et puis elle riait de si bon cœur aux marionnettes!" But whilst indulging in diamonds and puppet-shows, the Marchioness found time to translate Newton's "Principia" from Latin into French, and produced besides numerous learned memoirs, one of which, "Institutions de Physique," was dedicated to her sons in words which, although written more than a century and a half ago, might have been uttered yesterday—"J'ai toujours pensé que le devoir le plus sacré des hommes était de donner à leurs enfants une éducation qui les empêchât dans un âge plus avancé de regretter leur jeunesse, qui est le seul temps où l'on puisse véritablement s'instruire." We find her returning to the same theme in a little essay, "Traité du bonheur," a curious mixture of feelings reflecting very vividly the varying moods of this remarkable woman:—"Nous n'avons rien à faire en ce monde qu'à nous procurer des sensations agréables," she writes; whilst on another page we read, in an eulogistic commentary on the benefits of study more especially to women—"Quand, par hasard, il s'en trouve quelqu une née avec une âme assez élevée, il ne lui reste que l'étude pour la consoler de toutes les exclusions et de toutes les dépendances auxquelles elle se trouve condamnée par état," M. Rebière does not omit to include amongst his memorable women Hypatia, with whose memoir the volume in fact opens.

In conclusion, M. Rebière devotes a couple of pages to suggestions for the making of a book which we fancy would be with difficulty kept within the modest limit of eighty pages, which the little pamphlet before us embraces. "Un livre à faire" remains, says M. Rebière, in which the influence direct and indirect exerted by women on the progress of science might be recorded, a book catholic enough not only to include the *savantes professionnelles*, but the *simples curieuses* or amateurs in science, amongst which George Sand finds a place, the *collaboratrices*, and finally those whose munificence and public spirit have earned for them the well-deserved title of *les protectrices*, instances of which we in this country have fortunately little difficulty in recalling. But possibly the most eloquent tribute which has ever been paid to any woman, and which might appropriately have found mention in M. Rebière's little volume, is that which was so pathetically inscribed by John Stuart Mill on the first page of his essay on "Liberty."

We are glad to learn that meanwhile M. Rebière is compiling a second and more elaborate volume in which women's relation to science will be discussed, upon which subject M. Rebière asks us to mention that he will gratefully receive any notes and suggestions.

G. C. FRANKLAND.

[1] "Les Femmes dans la Science." Conférence faite au cercle Saint-Simon le 24 Février 1894, par A. Rebière. (Paris: Librairie Nony et Cie, 1894.)

THE ELECTRIFICATION OF AIR.[1]

§ 1. THAT air can be electrified either positively or negatively is obvious from the fact that an isolated spherule of pure water, electrified either positively or negatively, can be wholly evaporated in air.[2] Thirty-four years ago it was pointed out by one of us [3] as probable that in ordinary natural atmospheric conditions, the air for some considerable height above the earth's surface is electrified,[4] and that the incessant variations of electrostatic force which he had observed, minute after minute, during calms and light winds, and often under a cloudless sky, were due to motions of large quantities of positively or negatively electrified air in the immediate neighbourhood of the place of observation.

§ 2. It was proved [5] by observations in the Old College of Glasgow University that the air was in general negatively electrified, not only indoors, within the old lecture room [6] of Natural Philosophy, but also in the out-of-doors space of the College Court, open to the sky, though closed around with high buildings, and between it and the top of the College Tower. The Old College was in a somewhat low situation, surrounded by a densely-crowded part of a great city. In the new University buildings, crowning a hill on the western boundary of Glasgow, similar phenomena, though with less general prevalence of negative electricity in the air, have been observed, both indoors, in the large Bute Hall, and in many other smaller rooms, and out-of-doors, in the court, which is somewhat similar to the courts of the Old College, but much larger. It is possible that the negative electricity found thirty years ago in the air of the Old College, may have been due to its situation, surrounded by houses with their fires, and smoking factory chimneys. In the New College much of the prevalence of negative electricity in air within doors has, however, been found to be due to electrification by the burning lamp [7] used with the quadrant electrometer; and more recent observations with electrification by flame absolutely excluded, throw doubt on the old conclusion, that both in town and country negative electrification is the prevailing condition of natural atmospheric air in the lower regions of the atmosphere.

§ 3. The electric ventilation found in the Old College, and described in § 299 of "Electrostatics and Magnetism," according to which air drawn through a chink, less than ½-inch wide, of a slightly open window or door, into a large room, showed the electrification which it had on the other side of the chink, whether that was the natural electrification of the open air, or positive or negative electrification produced by aid of a spirit lamp and electric machine in an adjoining room, has been tried again in the New College with quite corresponding results. It has also been extended to the drawing in of electrified air through a tube to the enclosure represented in Fig. 1 of the present paper; with the result that the water-dropping test indicated in the sketch, amply sufficed to show the electrification, and verify that it was always the same as that of the air outside. When the tube was filled with loosely packed cotton-wool the electrification of the entering air was so nearly annulled as to be insensible to the test.

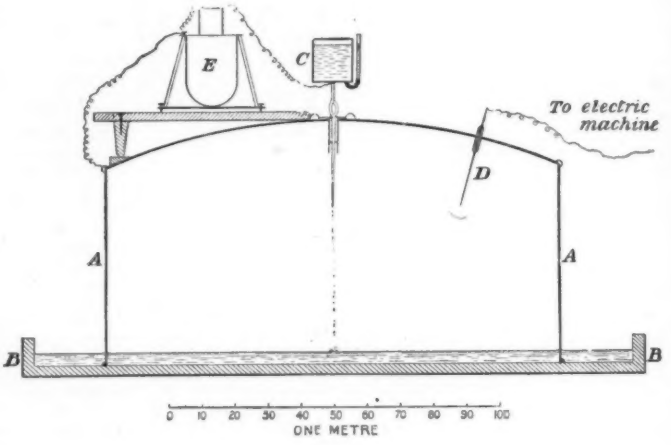


FIG. 1.

§ 4. The object proposed for the experiments described in the present communication was to find if a small unchanged portion of air could be electrified sufficiently to show its electrification by ordinary tests, and could keep its electrification for any considerable time; and to test whether or not dust in the air is essential to whatever of electrification might be observed in such circumstances, or is much concerned in it.

§ 5. The arrangement for the experiments is shown in the diagram, Fig. 1. A A is a large sheet-iron vat inverted on a large wooden tray B B, lined with lead. By filling the tray with water the air is confined in the vat. There are two holes in the top of the vat: one for the water-dropper C, and one for the charging wire D. Both the water-dropper, and the charging wire, ending with a pin-point as sharp as possible, are insulated by solid paraffin, which is surrounded by a metal tube, as shown in half size in Fig. 2. To start with they were supported by pieces of vulcanite embedded in paraffin. But it was found that after the lapse of some days (possibly on account of ozone generated by the incessant brush discharges), the insulation had utterly failed in both of them. The vulcanite pieces were then taken out, and solid paraffin, with the metal guard-tube round it to screen it from electrically influencing the water-dropper, was substituted. This has proved quite satisfactory: the water-dropper, with the flow of water stopped, holds a positive or a negative charge for hours.

§ 6. A quadrant electrometer E (described in "Electrostatics and Magnetism" §§ 346-353) was set up on the top of the vat near the water-dropper, as shown in Fig. 1. It was used with lamp and semi-transparent scale to indicate the difference of potential between the water-dropper and the vat. The sensibility

[1] A Paper by Lord Kelvin, P.R.S., and Mr. Magnus Maclean, read at the Royal Society on May 31.

[2] This demonstrates an affirmative answer to the question, Can a molecule of a gas be charged with electricity? (J. J. Thomson, "Recent Researches in Electricity and Magnetism," § 36, p. 53) and shows that the experiments referred to as pointing to the opposite conclusion are to be explained otherwise.

Since this was written, we find in the *Electrical Review* of May 18, on p. 571, in a lecture by Elihu Thomson, the following:—"It is known that as we leave the surface of the earth and rise in the air, there is an increase of positive potential with respect to the ground. . . . It is not clearly proven that a pure gas, rarefied or not, can receive and convey a charge. If we imagine a charged drop of water suspended in air and evaporating, it follows that, unless the charge be carried off in the vapour, the potential of the drop would rise steadily as its surface diminished, and would become infinite as the drop disappeared, unless the charge were dissipated before the complete drying up of the drop by dispersion of the drop itself, or conveyance of electricity by its vapour. The charge would certainly require to pass somewhere, and might leave the air and vapour charged."

It is quite clear that "must" ought to be substituted for "might" in this last line. Thus the vagueness and doubts expressed in the first part of the quoted statement are annulled by the last three sentences of it.

[3] "Even in fair weather the intensity of the electric force in the air near the earth's surface is perpetually fluctuating. The speaker had often observed it, especially during calms or very light breezes from the east, varying from 40 Daniel's elements per foot to three or four times that amount during a few minutes, and returning again as rapidly to the lower amount. More frequently he had observed variations from about 30 to about 40, and back again, recurring in uncertain periods of perhaps about two minutes. These gradual variations cannot but be produced by electrified masses of air or cloud, floating by the locality of observation."—Lord Kelvin's "Electrostatics and Magnetism," art. xvi. § 282.

[4] The out-of-doors air potential, as tested by a portable electrometer in an open place, or even by a water-dropping nozzle outside, two or three feet from the walls of the lecture room, was generally on these occasions positive, and the earth's surface itself therefore, of course, negative—the common fair weather condition—which I am forced to conclude is due to a paramount influence of positive electricity in higher regions of the air, notwithstanding the negative electricity of the air in the lower stratum near the earth's surface. On the two or three occasions when the in-door atmospheric electricity was found positive, and, therefore, the surface of the floor walls and ceiling negative, the potential outside was certainly positive, and the earth's surface out-of-doors negative, as usual in fine weather."—*Ibid.* § 300.

[5] *Ibid.* Q. 2, § 283. [6] *Ibid.* §§ 296-300.

[7] "Electrification of Air by Combustion," Magnus Maclean and Makita Goto, Philosophical Society of Glasgow, November 20, 1889; "Electrification of Air by Water Jet," Magnus Maclean and Makita Goto, *Philosophical Magazine*, August 1890.

of the electrometer was 21 scale divisions (half-millimetres) per volt, and as the scale was 90 centimetres long, difference of potentials up to 43 volts positive or negative, could be read by adjusting the metallic zero to the middle of the scale. A frictional plate-electric machine was used, and by means of it, in connection with the pin-point, the air inside the vat could be electrified either positively or negatively.

§ 7. The vat was fixed in position in the Apparatus Room of the Natural Philosophy Department of the University of Glasgow on December 13, 1893, and for more than three months the air inside was left undisturbed except by discharges from the pin-point through the electrifying wire, and by the spray from the water-dropper. Thus the air was becoming more and more freed of dust day by day. Yet at the end of the four months we found that the air was as easily electrified, either positively or negatively, as it was at the beginning; and that if we electrify it strongly by turning the machine for half an hour, it retains a considerable portion of this electrification for several hours.

§ 8. Observations were taken almost daily since December 13; but the following, taken on February 8, March 12, and April 23, will serve as specimens, the results being shown in each case by a curve. At all these dates the air must have been very free from dust. Both during the charging and during the observations the case of the electrometer and one pair of quadrants are kept metallically connected to the vat. During the charging the water-dropper and the other pair of quadrants were also kept in connection with the vat. Immediately after the charging was stopped the charging-wire was connected metallically to the outside of the vat, and left so with its sharp point unchanged in its position inside the vat during all the observations.

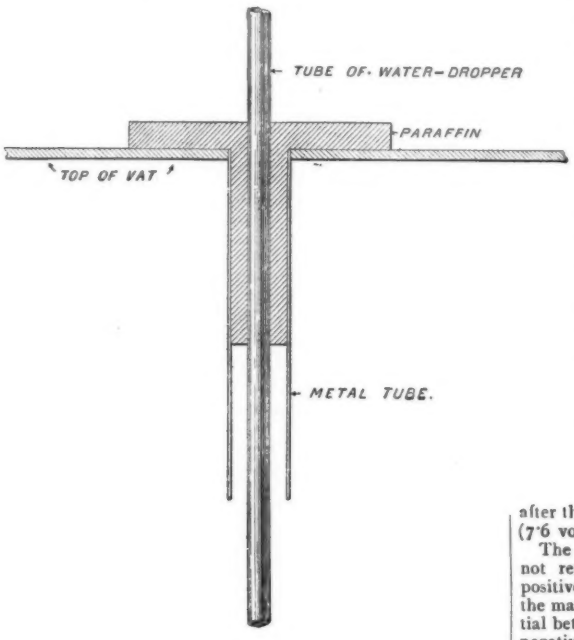


FIG. 2.

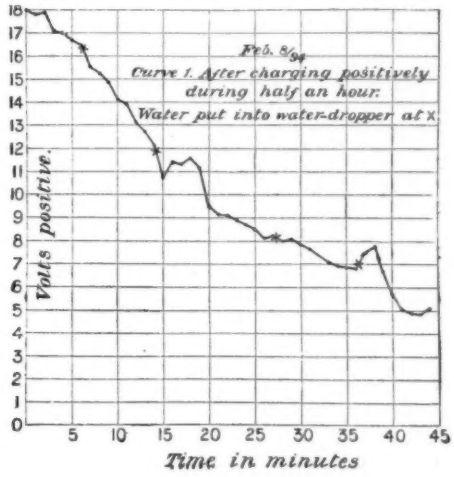
§ 9. *Curve* 1. *February* 8, 1894.—The friction-plate machine was turned positive for half an hour. Ten minutes after the machine stopped the water-dropper was filled and joined to one pair of quadrants of the electrometer, while the other pair was joined to the case of the instrument. The first reading on the curve was taken four minutes afterwards, that is, fourteen minutes after the machine stopped running (18 volts).

Curve 2. *March* 3, 1894.—The friction-plate machine was turned positive for five minutes. The water-dropper was filled and joined to the electrometer immediately after the machine stopped turning. The spot was off the scale, and nine minutes elapsed before it appeared on the scale. The first reading on the curve was taken one minute afterwards, or ten minutes after the machine stopped turning (35·25 volts).

Curve 3. *March* 12, 1894.—A Voss induction machine was joined to the charging wire, and run by an electric motor for four hours nineteen minutes. A test was applied at the beginning of the run to make sure that it was charging negatively; and a similar test when it was disconnected from the charging wire in the vat showed it to be still charging negatively. The water-dropper was joined to the electrometer, and the spot appeared on the scale immediately. The first reading on the curve was taken half a minute after the machine was disconnected (30·65 volts).

Curve 4. *April* 23, 1894.—The friction-plate machine was turned positive for thirty seconds, with water-dropper running and joined to the electrometer. Twenty seconds after the machine stopped the spot appeared on the scale, and the reading one and a half minutes after the machine stopped turning is the first point on the curve (7·3 volts).

Curve 5. *April* 23, 1894.—The friction-plate machine was turned negative for thirty seconds, with the water-dropper running and joined to the electrometer. Ten seconds afterwards the spot appeared on the scale, and the reading seventy seconds after the machine stopped turning is the first point on the curve (7·6 volts).

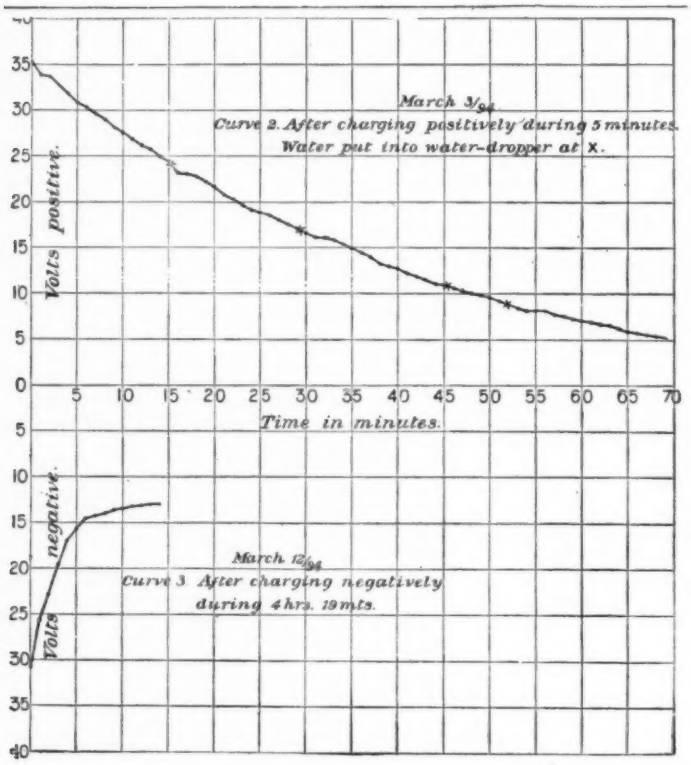


The curves show, what we always found, that the air does not retain a negative electrification so long as it retains a positive. We also found, by giving equal numbers of turns to the machine, that the immediately resulting difference of potential between the water-dropper and the vat was greater for the negative than for the positive electrification; though the quantity received from the machine was probably less in the case of the negative electrification, because the negative conductor was less well-insulated than the positive.

§ 10. On March 21, two U-tubes were put in below the edge of the vat, one on either side, so that it might be possible to blow dusty, or smoky, or dustless air into the vat. To one tube was fitted a blowpipe bellows, and by placing it on the top of a box in which brown paper and rosin were burning, the vat was filled with smoky air. Again, several layers of cotton-wool were placed on the mouth of the bellows, so as to get dustless air into the vat. The bellows were worked for several hours on four successive days, and we found no appreciable difference (1) in the ease with which the air could be electrified by discharges from the wire connected to the electric machine, and (2) in the length of time the air retains its electrification.

But it was found that, as had been observed four years ago with the same apparatus,[1] with the water-dropper insulated and connected to the electrometer, and no electrification of any kind to begin with, a negative electrification amounting to four, five, or six volts gradually supervened if the water-dropper was

[1] Maclean and Goto, *Philosophical Magazine*, August 1890.



kept running for 60 or 70 minutes, through air which was dusty, or natural, to begin with. It was also found, as in the observations of four years ago, that no electrification of this kind was produced by the dropping of the water through air purified of dust.

The circular bend of the tube of the water-dropper shown in the drawing was made for the purpose of acting as a trap to prevent the natural dusty air of the locality from entering the vat when the water-dropper ran empty.

§ 11. The equilibrum of electrified air within a space enclosed by a fixed bounding surface of conducting material presents an interesting illustration of elementary hydrostatic principles. The condition to be fulfilled is simply that the surfaces of equal electric "volume-density" are surfaces of equal potential, if we assume that the material density of the air at given temperature and pressure is not altered by electrification. This assumption we temporarily make from want of knowledge; but it is quite possible that experiment may prove that it is not accurately true; and it is to be hoped that experimental investigation will be made for answering this very interesting question.

§ 12. For stable equilibrium it is further necessary that the electric density, if not uniform throughout, diminishes from the bounding surface inwards. Hence, if there is a portion of non-electrified air in the enclosure it must be wholly surrounded by electrified air.

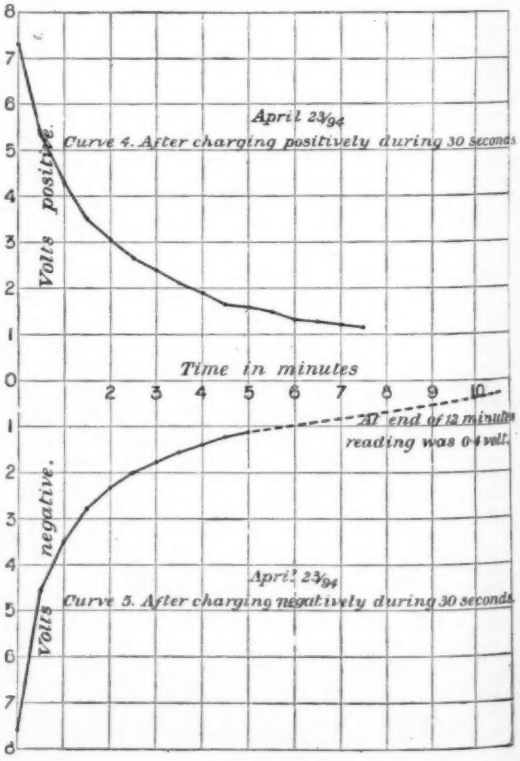
§ 13. We may form some idea of the absolute value of the electric density, and of the electrostatic force in different parts of the enclosure, in the electrifications found in our experiments, by considering instead of our vat a spherical enclosure of diameter intermediate between the diameter and depth of the vat which we used. Consider, for example, a spherical space enclosed in metal of 100 cm. diameter, and let the nozzle of the water-dropper be so placed that the stream breaks into drops at the centre of the space. The potential shown by the electrometer connected with it, being the difference between the potentials of the air at the boundary and at the centre, will be the difference of the potentials at the centre due respectively to the total quantity of electricity distributed through the air and the equal and opposite quantity on the inner boundary of the enclosing metal; and we therefore have the formula:—

$$V = 4\pi \int_0^a \left(\frac{r^2}{r} - \frac{r^2}{a}\right) dr,$$

where V denotes the potential indicated by the water-dropper, a the radius of the spherical hollow, and ρ the electric density of the air at distance r from the centre. Supposing now, for example, ρ to be constant from the surface to the centre (which may be nearly the case after long electrification as performed in our experiments), we find $V = \frac{2}{3}\pi\rho a^2$; whence $\rho = 3V/2\pi a^2$.

To particularise further, suppose the potential to have been 38 volts or 0·127 electrostatic c.g.s. (which is less than the greatest found in our experiments) and take $a = 50$ cm.: we find $\rho = 2{\cdot}4.10^{-6}$. The electrostatic force at distance r from the centre, being $\frac{4}{3}\pi\rho r$, is therefore equal to $10^{-4}r$. Hence a small body electrified with a quantity of electricity equal to that possessed by a cubic centimetre of the air, and placed midway ($r = 25$) between the surface and centre of the enclosure experiences a force equal to $2{\cdot}4.10^{-6}.25$, or 6×10^{-5}, or approximately 6.10^{-5} grammes weight. This is 4·8 per cent. of the force of gravity on a cubic centimetre of air of density 1/800.

§ 14. Hence we see that, on the supposition of electric density uniform throughout the spherical enclosure, each cubic centimetre of air experiences an electrostatic force towards the boundary in simple proportion to distance from the centre, and amounting at the boundary to nearly 10



per cent. of the force of gravity upon it; and electric forces of not very dissimilar magnitudes must have acted on the air electrified as it actually was in the non-spherical enclosure used in our experiments. If natural air or cloud, close to the ground or in the lower regions of the earth's atmosphere, is ever, as in all probability it often is, electrified to as great a degree of electric density as we have found it within our experimental vat, the natural electrostatic force in the atmosphere, due as it is, no doubt, to positive electricity in very high regions, must exercise an important ponderomotive force quite comparable in magnitude with that due to difference of temperatures in different positions.

It is interesting to remark that negatively electrified air over negatively electrified ground, and with non-electrified air above it, in an absolute calm, would be in unstable equilibrium; and the negatively electrified air would therefore rise, probably in large masses, through the non-electrified air up to the higher regions, where the positive electrification is supposed to reside. Even with no stronger electrification than that which we have had within our experimental vat, the moving forces would be sufficient to produce instability comparable with that of air warmed by the ground and rising through colder air above.

§ 15. During a thunderstorm the electrification of air, or of air and the watery spherules constituting cloud, need not be enormously stronger than that found in our experiments. This we see by considering that if a uniformly electrified globe of a metre diameter produces a difference of potential of 38 volts between its surface and centre, a globe of a kilometre diameter, electrified to the same electric density, reckoned according to the total electricity in any small volume (electricity of air and of spherules of water, if there are any in it), would produce a difference of potential of 38 million volts between its surface and centre. In a thunderstorm, flashes of lightning show us differences of potentials of millions of volts, but not perhaps of many times 38 million volts, between places of the atmosphere distant from one another by half a kilometre.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Council of the Owens College has, on the recommendation of the Senate, made the following appointments to Fellowships in the College:—Bishop Berkeley—Dr. A. W. Crossley in Chemistry, A. H. Jameson in Engineering; Honorary Research—Wilmot Holt, junr., in Chemistry.

MR. ANDREW J. HERBERTSON, of Edinburgh, has been appointed Lecturer on Geography at the Owens College, Manchester, in succession to Mr. Yule Oldham.

SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. xvi. 3. (Baltimore: July 1894.)—A class of uniform transcendental functions, by Dr. T. Craig (pp. 207-220), gives another mode of forming a certain transcendental function first introduced by M. Picard (*Comptes Rendus*, 1878), and which does not seem to have been subsequently discussed. M. G. Humbert (pp. 221-253), writing "Sur les surfaces de Kummer elliptiques," after mentioning that Cayley's *tetrahedroid* is a particular case of a Kummer surface with six double points, applies himself to the problem of determining whether any other of these surfaces possess similar properties.—Mr. Basset contributes a memoir on the deformation of thin elastic plates and shells (pp. 254-290). The origin of the investigation appears to be the dissatisfaction Mr. Basset has felt with Mr. Love's treatment of the theories of thin plates, shells, and wires in the second volume of his book on "Elasticity."

Jahrbuch der k. k. geolog. Reichsanstalt Wien. Bd. xliii. Heft 3 and 4, March 1894.—Although Graz is one of the few localities in the Central Alps in which palæozoic strata are present containing good fossils, the exact age of these strata and their parallelism with the Silurian and Devonian strata of extra-Alpine regions have remained uncertain. The richly fossiliferous Coral-limestone of the Graz succession was determined as mid-Devonian by Suess, Stache, and others. Hoernes, on the other hand, thought it Lower Devonian. Now, for the first time, the Corals have been made the subject of a detailed study.—Dr. K. A. Penecke contributes a paper to the *Jahrbuch*, "On the Devonian strata of Graz," in which he proves that the "Coral limestone" and the "Calceola horizon" immediately above it are the uppermost bed of the *Lower Devonian* series. The age of the palæozoic strata of Graz ranges, according to Dr. Penecke, from the oldest Silurian to the youngest Devonian, and may possibly include a part of the Lower Coal Measures.—The monograph of the Raibl strata, by Baron von Wöhrmann, marks a considerable advance in our knowledge of Alpine Trias. The author's previous papers on the Raibl fauna in North and South Tyrol, have paved the way for this general paper. All the Raibl facies known in the Alps are described, the species contained in them reviewed, the indications of the geographical conditions discussed, and comparative references made to extra-Alpine seas in the same period. The subject is one of the most complex, but its treatment is searching, concise, and exhaustive. We note, almost with relief, the entire absence of the speculative method and wordy argument too frequently seen of late in matters concerning the Alps.

Bd xliv. Heft 2, June 1894.—"On the newer literature of the Alpine Trias," by Dr. A. Bittner. The personal and polemical tone of this paper renders it somewhat remarkable. By way of reviewing the terminology and literature of the Alpine Trias, Dr. Bittner exposes scathingly the fashion of new name-giving on insufficient grounds, the prejudice and obstinacy with which a name once given is apt to be retained, and the danger to science of subsequent attempts to modify the original meaning of a name, and prop a deservedly falling fabric. The writings of Mojsisovics are those which specially come under the whip. We are told, for example, that in studying "the Cephalopoda of the Hallstadt Limestone," one of the greatest works of Mojsisovics, we must read everywhere—instead of Mediterranean Trias, Alpine Trias; instead of Juvavic horizon, Noric horizon; instead of Noric horizon, Ladinian horizon; the author of the work himself having entirely departed from the geological conceptions for which the names were created! Dr. Bittner's paper is, to say the least, breezy; but, on the principle of the old proverb, "It's an ill wind, &c.," there is no doubt it will have a healthful effect in blowing away some of the cobwebs of tradition from a study which nature had already made so difficult and so fascinating.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 10.—"The Composition of Atmospheres which Extinguish Flame." By Dr. Frank Clowes, Professor of Chemistry, University College, Nottingham.

The statements usually published, as to the proportion of carbon dioxide in air necessary to extinguish a candle flame, vary widely. The present investigation was undertaken with the object of fixing the minimum proportion of carbon dioxide and of nitrogen gas, which, when mingled with air, will extinguish flame; and with the further object of ascertaining also the minimum proportion of each of these gases, which is necessary to extinguish the flames of different combustible substances, including those of certain gases.

The method of experimenting, which was devised, prevented the introduction of errors arising from the incomplete mixture of the gas with the air, from the solubility of carbon dioxide in water, and from the effect of carbonic dioxide produced from the flame during its combustion. The proportions of gas and air in the mixtures used were checked by analysis and were shown to be accurate, and duplicate experiments agreed in their results closely.

A preliminary series of experiments proved that, within the wide limits selected, the extinctive proportion of carbon dioxide was independent of the *size* of the flame of any particular combustible which was introduced into the mixture.

An extended series of experiments was then made to ascertain the minimum extinctive proportion of carbon dioxide for flames of very various description. The results arrived at showed that the flames of very different combustibles which were burnt from wicks, required a strikingly similar proportion of carbon dioxide in the air for their extinction. Thus the percentage of carbon dioxide necessary for the extinction of the flames of the following combustibles were: for absolute alcohol, 14; for methylated alcohol, 13; for paraffin oil, 15; for mixed colza and petroleum, 16; and for a candle, 14.

The extinctive proportions of the gas for the flames of various gases burnt from a jet, on the other hand, showed wide differences. The minimum percentages of carbon dioxide gas in air required for the extinction of the various flames of gases were as follows: for hydrogen, 58; for carbon monoxide, 24; methane, 10; ethylene, 26; and for coal-gas, 33. These numbers show no relation, as they might have been expected to do, to the volume of oxygen necessary for the combustion of the different gases.

A second series of experiments was then undertaken to ascertain the minimum proportion of nitrogen which must be added to the air in order to render it extinctive of the various flames already specified. It was found necessary in every case to add nitrogen in larger proportion than carbon dioxide to the air, in order to secure the extinction of a flame. The superior extinctive power of carbon dioxide over that of nitrogen is probably connected with its higher specific heat, and with its greater density.

Characteristic differences were noticed between the behaviour of wick-fed flames and flames supplied with gas from a jet, during the process of their extinction. The wick-fed flame gradually *diminished* in size until it ultimately dwindled away. The gas-fed flame, on the other hand, rapidly *increased* in dimensions, at the same time becoming more and more pale; and it became so pale at last as to be often visible with difficulty, so that it was not easy to mark the moment of its extinction. Probably the extinction of both classes of flames was primarily due to the lowering of their temperatures. In the case of the wick-fed flames, however, the reduction of their temperature led to the diminution of the supply of gaseous and vapourous fuel to the flame, and the flame ultimately died because it was starved. In the case of gas-fed flame the supply of fuel, being independent of the flame, was maintained, and the flame perished from lowering of temperature only; in its effort to obtain an adequate supply of oxygen in the diluted air, however, it expanded its surface, and it thus undoubtedly hastened the reduction of temperature which led to its extinction.

The very high proportion of carbon dioxide in air which is necessary for the extinction of the hydrogen flame has received an important and interesting application. One of the most serious troubles to which the miner is exposed when using his safety-lamp, is the extinction of its flame by air containing carbon dioxide. In most mines the lamp cannot be relighted with safety, since a naked flame would cause danger in the possible presence of inflammable gas. The loss of the flame therefore implies the necessity of the miner moving in darkness often through a considerable distance to a place where the wick may be relighted without risk. The safety-lamp for delicate and accurate gas-testing, which has been already described by the author (*Roy. Soc. Proc.* vol. lii. p. 486), provides the means of avoiding this inconvenience and possible danger. Without opening this lamp it can be made to burn either an ordinary oil-flame alone, or a hydrogen flame alone, or both these flames may be made to burn side by side. If the miner is approaching a part of the mine in which the proportion of carbon dioxide may be extinctive of his oil-flame, he would turn on the hydrogen-flame as an auxiliary. If the oil-flame becomes extinguished, he has proof that he has entered air containing at least fifteen per cent. of carbon dioxide; but he can withdraw from it with his hydrogen-flame still burning, and in purer air the hydrogen-flame will at once rekindle the wick and give him his illuminating flame once more. Under certain circumstances he might even with safety pass though the foul air, and in a similar way regain his oil-flame. It is even possible to arrange the hydrogen-jet so close to the wick, that the oil-flame is more or less perfectly maintained by the hydrogen-flame even in the presence of much carbon dioxide.

The question has been raised whether it is safe to enter air which contains sufficient carbon dioxide to extinguish a candle-flame. This question is usually answered in the negative. But recent experiments made by J.R. Wilson (*Amer. Journ. Pharm.* 50, No. 12), seem to prove that rabbits can breathe for an hour with entire immunity from harm or even discomfort air containing 25 per cent. of admixed carbon dioxide, and that when the air contains 50 per cent. of the gas it is by no means immediately fatal to a rabbit which is immersed in it. Now air containing 15 per cent. of carbon dioxide at once extinguishes an ordinary candle-flame or oil-flame. Hence it appears that air may contain a considerably larger proportion of carbon dioxide than that which is necessary to extinguish the flame of a lamp or candle, and yet be competent to maintain life when it is breathed. This statement is fully supported by experiments made by Dr. Angus Smith, as well as by the experience of miners and others.

The following conclusions may be drawn from the experiments referred to above:—

(1) That the extinction of a flame depends not only upon the *quantity* but also upon the *quality* of the extinctive gas present in the air; carbon dioxide uniformly exerting a more powerfully extinctive effect than nitrogen.

(2) That wick-fed flames burning different combustibles show a remarkable uniformity in the minimum proportion of an extinctive gas in air necessary for their extinction.

(3) That this uniformity is not shown by flames fed by a gas burning from a jet; and no simple relation is apparent in the case of the gas-fed flames between the proportion of oxygen present in the diluted air and the proportion of oxygen requisite for the complete combustion of the gas.

(4) That the hydrogen flame requires for its extinction the presence in air of a very high proportion of extinctive gas; it may therefore be advantageously used as an auxiliary flame for maintaining an oil-flame in the foul air of a mine or other locality.

(5) Since an ordinary candle-flame or oil-flame is extinguished by the presence of about 15 per cent. of carbon dioxide in air, and air containing over 25 per cent. of carbon dioxide has been breathed with perfect safety for more than an hour, the extinction of an ordinary oil- or candle-flame in any particular atmosphere must not be taken as proof that that atmosphere contains so much carbon dioxide as to be dangerous to life when it is breathed.

(6) A more satisfactory indication of the presence of a dangerous proportion of carbon dioxide is furnished by the change of colour of the hydrogen flame from reddish to blue-grey. This change begins when 2 per cent. of carbon dioxide is present in the air; it becomes very pronounced as the proportion of the gas present increases. When 30 per cent. or upwards is present the flame is of a pronounced blue colour and also increases in height with the increased proportion of the gas, to an extent which is easily measured on a scale.

May 31.—"Note on the Possibility of obtaining a Unidirectional Current to Earth from the Mains of an Alternating Current System." By Major P. Cardew.

June 21.—"Degenerations consequent on Experimental Lesions of the Cerebellum." By Dr. J. S. Risien Russell.

The paths which degenerate after ablation of one lateral lobe of the cerebellum, and after extirpation of its middle lobe, are discussed in this paper.

Degenerated fibres are found in all the peduncles on the same side after the former operation, and in the superior peduncle of the opposite side. The position occupied by these degenerated fibres, in this peduncle, is that of fibres which degenerate in both superior peduncles after the cerebellum has been divided into two lateral halves by a mesial incision. The degenerated fibres in the superior peduncle of the side of the lesion decussate in the posterior quadrigeminal region, and pass to the opposite red nucleus and optic thalamus. Those fibres which degenerate in the middle peduncle pass chiefly to the grey matter of the opposite side of the pons. Of the fibres which degenerate in the inferior peduncle, the majority occupy the lateral region of the medulla, becoming more and more scattered as they pass down. These can no longer be said to form a tract below the level of the superior pyramidal decussation; but a few scattered fibres occupy the antero-lateral region of the cervical cord, beyond which none can be traced. Degenerated fibres pass to both inferior olives from this peduncle; but no well-marked tract to the opposite inferior olive was found.

After extirpation of the middle lobe of the cerebellum, degenerated fibres were found in all the peduncles. Those in the superior peduncle decussate in the region of the posterior corpora quadrigemina, and terminate in the opposite red nucleus. The degenerated fibres in the middle peduncle behave much as do those which result from ablation of one lateral lobe of the cerebellum; and the same may be said with regard to the degenerated fibres in the inferior peduncle.

No degeneration was found in the fillet, posterior longitudinal bundles, pyramids, ascending root of the fifth nerve, the roots of the cranial and spinal nerves, and in the spinal cord, forming an antero-lateral tract throughout its whole length.

Physical Society, June 22.—Prof. W. E. Ayrton, F.R.S., Past-President, in the chair.—Captain Abney, before exhibiting his photographs of flames, demonstrated that a candle flame contains solid particles by passing a beam of polarised light though it, the track of the beam through the flame being clearly seen in one direction, whilst in a direction at right angles it was practically invisible. The same thing was also shown by passing the light through a turbid liquid. Photographs of argand and candle flames with pencils of sunlight and electric light passing through, were then exhibited showing similar phenomena. Several series of photographs of flames of candles and various forms of gas-burner taken with diminishing exposures were then shown in order to illustrate the different luminosities at different parts of the flame. Those taken with long exposures showed the bright parts nearly equally white, but as the time of exposure diminished only the most luminous portions were recorded on the plate. From the photographs the author concluded that when used with a slit as a photometric standard the argand burner was unsuitable, for portions of different luminosity come into view when the slit is approached or receded from. The ordinary fish-tail burner was better in this respect. Questions were asked and remarks made by Prof. S. P. Thompson, Prof. Perry, and Mr. Trotter, in reply to which Captain Abney said dropped shutters with slits from one inch to one-sixteenth inch wide had been employed, and some of the exposures were only a few thousandths of a second. The displacement caused when the object was not stationary could easily be allowed for when the velocity of the shutter was known.—Prof. O. Henrici read a paper on an elementary theory of planimeters. Considering the generation of areas by the motion of straight lines, the author defined the sense in which such areas are to be taken. Choosing the positive sense of a line O T of variable length as outwards from the centre O about which it turns, and the positive direction of rotation as counter-clockwise, the following rule for determining the sense of an area was given. Imagine yourself standing at a point P, and looking along the positive sense of O T, whilst it passes over P, then the area near P will be swept out in *a positive sense if O T crosses you from right to left*, otherwise it will be negative. Applying this rule to closed curves of any shape, it was shown that if T goes once round the boundary, any area outside the curve was necessarily swept over as many times in the negative sense as in the positive sense, therefore these areas cancelled, and also that the sense of any part of an area depends on the sense of its boundary. Passing on to the consideration of areas generated by a line (or rod) of fixed length, which moves anyhow in a plane and returns to its initial position, Prof. Henrici showed by taking instantaneous centres, that the same rule regarding the sense of the areas holds, and that the area generated by the rod is equal to the difference between the areas of the two closed curves traced by its ends. In the particular case where one end of the rod moves forwards and backwards along the same path the area swept out by the rod is equal to that of the closed curve traversed by the other end. This is the theory of Amsler's planimeter, for the area of the curve whose boundary is traversed by the tracer is the same as that swept out by the rod carrying the tracer when the pole is outside the closed curve. By resolving small motions of the rod in two component parts, a translation parallel to itself, and a rotation about the point in which the plane of the registering wheel cuts the rod, the author showed that the areas swept out by the translations were registered by the wheel, whilst the sum of those generated during the rotations cancel. Cases where the pole is inside the curve were next considered, and the constant then to be added to the wheel reading determined. Instead of registering the translation by a wheel whose axis is parallel to the rod, a knife-edged wheel which slides and turns freely on an arm perpendicular to the rod would serve the same purpose. This is the principle of Hine and Robertson's planimeter. In the actual instrument, however, the arm is inclined at about 10° to the rod, and is therefore inaccurate. In the "hatchet" planimeter a bent rod terminates at one end in a tracing point, and at the other in a convex knife-edge or "keel," whose plane contains the point. The area of the curve whose boundary is traversed by the point is approximately equal to twice that of the sector included between the initial and final positions of the rod. The approximation results from the fact that the area of the curve traced by the keel is not zero. At the meeting the question of reducing the area of the keel curve was discussed at some length, the author showing that in the case of a curve symmetrical about a line, it was possible to reduce this area practically to zero. Even for unsymmetrical curves one could obtain a symmetrical one of double the area by drawing a line, cutting the curve, and supposing the area turned over about this line. Prof. Perry inquired if the author's conclusion was that the "hatchet" planimeter and the Hine and Robertson instrument were inaccurate? If so, he was at a loss to understand why the latter gave results more nearly correct than Amsler's. Mr. Blakesley pointed out that if both arms of a jointed planimeter be simultaneously moved over curves the total reading should give the sum of the two areas traced out if taken in the proper senses. Mr. A. P. Trotter directed attention to an article by the inventor of the "hatchet" in the current number of *Engineering*. Dr. Macfarlane Gray said he had examined the proof given in *Engineering*, and found no error. He then showed how the Amsler planimeter could be explained in a simple geometrical manner by drawing radial lines through the pole and intersecting the curve. Moving the tracer along these radii added nothing to the area; motion along the arcs was the important component. Mr. O. G. Jones and Prof. Thompson also took part in the discussion.—Mr. F. W. Hill made a communication on the "hatchet" planimeter. In this paper the author takes a point within the area to be measured, and divides the area into elementary triangles with this point as apex. The tracing point of the planimeter is then supposed to start from the apex and trace out one of the triangles. The inclination between the initial and final positions of the "hatchet" is then expressed in terms of the angle at the apex, the radius vector, and the length of the planimeter. By expanding and integrating the expression, it is shown that twice the area between the initial and final position of the planimeter, after tracing all the triangles, is represented by an infinite series of terms, the first of which is the area of the curve, the second is proportional to the moment of inertia of the area about the point, the third proportional to its first moment about the same point. The higher terms are usually small enough to be neglected. Starting the tracer at the centroid of the area causes the third term to disappear, and the second has its minimum value, so that this is the starting-point recommended. The magnitude of the errors caused by neglecting the various terms are discussed in some detail. In the author's opinion, the instrument can never be strictly accurate; but usually the errors are within the limits of observation. Prof. Henrici did not agree with the statement that the instrument was necessarily inaccurate, and thought geometry might aid analysis to find the proper starting-point. For a symmetrical curve he had shown that a point existed, starting from which the area traced by the hatchet end was zero. Dr. Macfarlane Gray thought Prof. Henrici's latter argument was vitiated by his figure not being correctly drawn; but this Prof. Henrici disputed. Mr. O. G. Jones said Prof. Henrici's construction was not obvious, for the cusp curves traced by the "hatchet" end depended on the starting-point. Mr. Yule suggested that by shortening the planimeter it might be possible to bring the third and second terms of Mr. Hill's formula into greater prominence, and, by going round the curve more than once, determine the first and second moments.—A paper on a new integrating apparatus, by Mr. A. Sharp, was taken as read. The paper describes an improved form of harmonic analyser, giving the amplitude and epoch of each constituent term, the mechanism of which is an inversion of that described in a communication made to the Society on April 13. Numerous drawings accompany the paper, showing the various parts in detail. The mechanism is also shown to be applicable for integraphs, and by suitable modification may be employed for mechanically integrating differential equations of various forms. A paper on magnetic shielding by a hollow cylinder, by Prof. Perry, and another on "Clark's cells," by Mr. S. Skinner, were postponed.

Geological Society, June 20.—Dr. Henry Woodward, F.R.S., President, in the chair.—On deep borings at Culford and Winkfield, with notes on those at Ware and Cheshunt, by W. Whitaker, F.R.S., and A. J. Jukes-Browne. Four borings at Culford, Winkfield, Ware, and Cheshunt were described in detail, so far as the specimens examined would permit; these were few in the case of Culford, but many from the other borings. The interest of the Culford boring centred in its striking the Palæozoic floor at the small depth of 637½ feet; but the age of the slaty rocks cannot be determined. Although

only 20 miles east of Ely, no Jurassic rocks exist, and the Lower Cretaceous series is only about 32 feet thick, the beds differing greatly from those of Cambridgeshire, but resembling those of the same age in the Richmond boring. The Winkfield boring (3½ miles west-south-west of Windsor) was remarkable for having been successful in obtaining water from the Lower Greensand, and for the great depth (1243 feet) to which it was carried for this purpose, the Gault being unusually thick. The boring at Ware was for the first time described in detail, and former accounts were corrected from specimens preserved by the New River Company. By this means, and with the assistance of Mr. W. Hill, the authors were able to give a fairly complete account of the rocks, and to determine the limits of the divisions of the Upper Cretaceous series. They denied the existence of Lower Greensand at this locality. Of the boring at Cheshunt a complete account was given, based on information and specimens supplied by Mr. J. Francis, the engineer of the New River Company. The paper concluded with a tabular view of all the borings in the East of England, showing the level below ordnance datum at which the Palæozoic floor occurs in each. The President, Prof. Boyd Dawkins, Prof. Judd, and Mr. Topley spoke upon the subject of the paper, and Mr. Whitaker briefly replied.—The Bargate Beds of Surrey and their microscopic contents, by Frederick Chapman. This was an attempt to correlate the Bargate Beds of Guildford and its vicinity with the members of the Lower Greensand as known elsewhere in the south-east of England. Mr. T. Leighton, Prof. Judd, Mr. Whitaker, Dr. G. J. Hinde, Mr. Topley, and Prof. T. Rupert Jones offered some remarks upon the paper.—On deposits from snowdrifts, with special reference to the origin of the loess and the preservation of mammoth-remains, by Charles Davison. When the temperature is several degrees below freezing-point, snow recently fallen is fine and powdery, and is easily drifted by the wind. If a fall of snow has been preceded by dry frosty weather, the interstitial ice in the frozen ground is evaporated, and the dust so formed may be drifted with the snow and deposited in the same places. The snowdrifts as a rule are soon hardened by the action of the sun or wind, and the dust is thus imprisoned in the snow. As the snow decays, by melting and evaporation, a coating of dust is extruded on the surface of the drifts, and, increasing continually in thickness as the snow wastes away, is finally left upon the ground as a layer of mud, which coalesces with that of previous years. The deposit so formed is fine in texture, unstratified, and, as experiments show, mica-flakes included in it are inclined at all angles to the horizon. The author described several such deposits both in this country and in the Arctic regions; and suggested (1) that the loess is such a deposit from snowdrifts, chiefly formed when the climate was much colder, but still very slowly growing; (2) that mammoths suffocated in snowdrifts are subsequently embedded, and their remains preserved in the deposits from them; and (3) that the ground-ice formation of Alaska, &c., is the remains of heavy snowdrifts when the coating of earth attained a thickness greater than that which the summer heat can effectually penetrate. Mr. Davison's theory did not find much support. During the discussion upon it, Mr. Oldham said that he happened to have a personal acquaintance with the deposits left after the melting of snow and with the loess. The former were found in sheltered spots on the ridges of the Himalayas, which are annually covered with snow, but (so far as his experience went) they were denser and more compact than the true loess; they were, in fact, dried muds, while the true loess was a dust. In the hills of the western frontier of India, where loess was largely developed and still in course of formation, the distribution, surface-contour, and constitution showed it to be a wind-blown dust deposit, though it passed into deposits which had been rearranged by water. Part of this lay at altitudes where snow fell each year, but it was equally well and typically developed below the level at which snow usually fell, and where it was not preceded by a long frost nor lasted long enough to form extensive drifts. He did not think that the true loess could originate from the solid matter left by melting snow, and it could certainly be formed without the aid of snow. Prof. Blake, Prof. Boyd Dawkins, and Dr. W. F. Hume also spoke.—Additions to the fauna of the *Olenellust*-zone of the north-west Highlands, by B. N. Peach, F.R.S. New material obtained by the officers of the Geological Survey having been placed in the author's hands, he was enabled to add information concerning the species of *Olenellus* previously described by him (*O. Lapworthi*); he also described a new variety of this species, three new species of the genus, a new subgenus of *Olenellus*, and a form provisionally referred to *Bathynotus*. He discussed certain theoretical points based upon the study of the remains described in the paper, and stated that these make it probable that the dispersal of the Olenellids was from the Old World towards the New. Dr. Hicks and Dr. G. J. Hinde spoke upon the subject.—Questions relating to the formation of coal-seams, including a new theory of them: suggested by field and other observations made during the past decade on both sides of the Atlantic, by W. S. Gresley. A number of new facts were described, and the bearing of these and of previously recorded facts upon the origin of coal was discussed, special reference being made to the Pittsburgh coal. He maintained that the evidence pointed to the formation of coal on the floor of an expanse of water, by vegetable matter sinking down from floating "islands" of vegetation, which may have been of very large size, and enumerated cases of such "islands" or "rafts" of vegetation which have been described as existing in modern times.—Observations regarding the occurrence of anthracite generally with a new theory as to its origin, by the same author. After discussing Dr. J. J. Stevenson's theory of the origin of anthracite, the author described the nature and mode of occurrence of the anthracites of Pennsylvania, and gave his reasons for concluding that the de-bituminisation of coal was not produced by dynamic metamorphism during mountain-building, but rather by previously-applied hydrothermal action. He further discussed the applicability of his theory to other cases of anthracite, including that of South Wales and Ireland. In the discussion that followed, Prof. Boyd Dawkins pointed out that the anthracite-fields of South Wales and of Ireland are exactly in those places where the coal-seams have suffered most from crushing and faulting, and that therefore there is distinctly a connection between the exertion of dynamical force and the anthracitic condition. This also applies to the Irish fields. In some cases a coal-seam can be traced into an anthracite seam. In his opinion the author's views would not explain the presence of anthracite in this country.—The igneous rocks of the neighbourhood of Builth, by Henry Woods.—On the relations of some of the older fragmental rocks in north-west Caernarvonshire, by Prof. T. G. Bonney, F.R.S., and Miss Catherine A. Raisin. In a recent paper on the felsites and conglomerates between Bethesda and Llanllyfni, North Wales, it was argued that, in the well-known sections on either side of Llyn Padarn, a great unconformity separates the rocks into two totally distinct groups. The authors of the present communication discussed at the outset the great physical difficulties involved in this hypothesis; a subject which, in their opinion, was passed over too lightly by the author of that paper. They further affirmed, in the course of a description of the sections, which are most clear and afford the best evidence:—(1) That the strike in both the supposed rock-groups is generally similar. (2) That the same is true of the dips. (3) That very marked identity of lithological characters may be found in rocks on either side of the alleged unconformity, specimens occasionally being practically indistinguishable. (4) That in no case, which has been examined, can any valid evidence be found in favour of the alleged unconformity, and that in the one, which is supposed to to the most satisfactory proof of it; the facts are wholly opposed to this notion. Prof. Blake, Dr. Hicks, and Mr. Whitaker discussed these views, and Prof. Bonney replied.

Royal Microscopical Society, June 20.—Mr. A. W. Bennett in the chair—Dr. J. E. Talmage described his method for mounting and staining the brine shrimp, *Artemia fertilis*.—Dr. W. H. Dallinger called attention to a stereoscopic photomicrograph of injected muscle which had been presented by Dr. W. C. Borden.—Dr. Dallinger exhibited and described a new form of mechanical stage for the microscope, which had been produced by Messrs. Swift. Further remarks were made by the chairman, Messrs. Comber, Swift, More, and Beck.—Mr. J. H. Harvey described a method of mounting opaque objects so that they could be moved in all directions whilst under examination.—Mr. T. Comber read a paper on the unreliability of certain characters generally accepted for specific diagnosis in the Diatomaceæ. A discussion ensued, in which the chairman, Prof. F. J. Bell, and Mr. J. Badcock took part.—Prof. Bell gave a *résumé* of Mr. F. Chapman's sixth paper on the Foraminifera of the Gault of Folkestone.

DUBLIN.

Royal Dublin Society, June 20.—Dr. W. Frazer in the chair.—Dr. Telford Smith and Prof. D. J. Cunningham, F.R.S., gave a lantern demonstration of two microcephalic brains. One of these weighed 352 grammes; the other 559 grammes. The authors contrasted these specimens with the brains of the ape and the quadruped. The cerebrum in each had not passed in its development beyond the quadrupedal stage. The initial growth disturbance must therefore have occurred about the fourth month of fœtal development. With the aborted occipital region there was associated a marked convolutionary disturbance. The arrangement of the gyri and sulci did not correspond with that present at any period of fœtal life. It resembled the simian more than the human type; and what was most remarkable was the mixture of low-ape and high-ape characters. In some respects, therefore, the convolutionary pattern resembled that of a baboon, and in others that of a chimpanzee or an orang. The authors referred to the various theories which had been put forward to account for the condition, and upon the whole seemed to favour that of Karl Vogt, although the arguments they brought forward were of a totally different character. The results at which the authors have arrived will shortly appear in the Society's *Transactions*.

PARIS.

Academy of Sciences, July 9.—M. Lœwy in the chair.—The death of M. Mallard, member of the Mineralogy Section, was announced.—On the photographs of the moon obtained with the great *coudé* equatorial of the Paris Observatory, by MM. Lœwy and Puiseux. (See our Astronomical Column.)—On some of the work done at Nice Observatory, by M. Perrotin. In connection with photographic exploration, the author observes that, in the sky regions examined, (1) the number of new asteroids (magnitudes 7–13) is much less than the number previously known; (2) only in the case of asteroids of the 13th magnitude are more now discovered than had been previously observed; (3) the total number of asteroids increases with decreasing magnitude as far as the 12th mag.—On new derivatives from benzoylbenzoic acid, by MM. A. Haller and A. Guyot.—Experimental production of the contagious peripneumonia of cattle by the aid of cultures. Demonstration of the specific character of *Pneumobacillus liquefaciens bovis*. Note by M. S. Arloing. The author concludes from his results quoted that (1) the virulent agent in contagious peripneumonia is an ordinary microbe, and (2) this microbe is the *Pneumobacillus liquefaciens bovis*.—Comparative researches on the products of the combustion of lighting-gas given by an Argand burner and an Auer burner, by M. N. Gréhant. The combustion products from the Auer burner yielded evidence of the presence of carbonic oxide to the extent of 1 in 2580, those from the Argand burner a trace only, estimated at 1 in 75,000.—Special images of the sun given by the simple rays corresponding to the dark lines of the solar spectrum, by M. H. Deslandres. The author gives the first results of a study of the surface layers of the sun by means of images formed by light from selected parts of the spectrum.—On the calorific radiations included in the luminous part of the spectrum, by M. Aymonnet. The following conclusions are deduced from a study of the spectra given by the Bourbouze and Drummond lamps and by the sun: (1) the eye does not perceive all the radiations between the red and violet; (2) the eye is not acted on by rays intercepted by water; (3) when the medium between the radiant source and the measuring apparatus contains water, there is an imperfect concordance between the distribution of heat and that of light in the same region of the spectrum; (4) the bright lines or bands which we can observe in a spectrum are only those or a part of those which pass through water.—On the polarisation of light diffused by roughened surfaces, by M. A. Lafay.—On the relation between the density of a saline solution and the molecular weight of the dissolved salt, by M. Georges Charpy. The density of a saline solution augments proportionally to the molecular concentration if it be admitted that the molecular weight of water at 0° is about 3×18. The densities of equally concentrated solutions of analogous salts are nearly proportional to their molecular weights.—On a new glucosane, lævoglucosane, by M. Tanret.—Syntheses by means of cyanacetic ether. Phenylcyanacetic ethers, by M. T. Klobb.—On paraphthalodicyanacetic ether, by M. J. Locher.—On pine tar, by M. Adolphe Renard.—The quantitative composition of creosotes from beech and oak, by MM. A. Béhal and E. Choay. Beechwood creosote is richer in guaiacol than that from oak.—Inuring ferments to antiseptics and the influence of this hardening on their chemical work, by M. J. Effront.—The nature of onychomycosis, demonstrated by culture and by inoculations, by M. J. Sabrazès.—On the coexistence of the sternum with the shoulder-girdle and lungs, by M. Alexis Julien. The sternum varies in its composition, form, and texture, in its development and even in its connections. Notwithstanding this great variability, certain constant features may be distinguished. The sternum always coexists with the shoulder-girdle and lungs, that is to say, all vertebrates which have a sternum have also lungs and shoulder-girdles, but the converse is not true.—On the insertion of the membrane of Corti, by MM. Coÿne and Canniew.—On the topography of the attached urethra, studied on sections of frozen subjects, by M. L. Testut.—On the measurement of the absorption of water by roots, by M. Henri Lecomte.—On the petrographic nature of the summit of Mont Blanc and the neighbouring rocks, by MM. J. Vallot and L. Duparc.

BERLIN.

Physical Society, June 1.—Prof. du Bois Reymond, President, in the chair.—Prof. König described a repetition of H. Müller's experiments on the part of the retina in which the sensation of light takes its origin, using, however, monochromatic light. Müller, as is well known, had localised it in the rods and cones by observing that the shadows cast by the blood-vessels of the retina execute movements, when the source of light is moved (Purkinje's experiment), which correspond to the distance between the blood-vessels and the layer of rods and cones. Prof. König had repeated the measurements on the normal eye of Dr. Zumft, whose constants he had accurately determined, using four kinds of monochromatic light, namely, that of the lithium line in the red, of the D sodium line, of the thallium line, and of the line F. He found as a result of fifteen separate determinations that the distance of the light-perceiving elements of the retina from the blood-vessels which give the shadows varies with the varying wave-lengths of the different lights, a result which can only be explained on the basis of Young's theory of colour-vision.—Dr. H. du Bois spoke on the changes of resistance of a bismuth spiral in a powerful magnetic field. This change, discovered by Lord Kelvin, had been measured in the case of bismuth in a magnetic field whose maximum strength was 12,000 C.G.S., and the curve of resistance in the field, compared with that of the resistance outside the field, was found to be at first concave upwards and then straight. The resistance in the field of maximum strength was 1·7 of that in zero field. The speaker, using some very powerful electromagnets which he had recently exhibited to the Society, and which gave an intensity of 38,000 C.G.S., had, in conjunction with Dr. Henderson, measured the resistance of spirals of pure bismuth, and found that the curve pursues a further straight-line course, so that the resistance in the field of greatest intensity is three times as great as in a field of zero intensity. The measurement of the resistances in a magnetic field at different temperatures had yielded interesting results. In weak fields a rise of temperature increased the resistance: in stronger fields the effect was less, and became zero in a field of 7000 C.G.S. In still stronger fields the resistance of the warm spiral was less than that of the cold. The experiments have so far been carried on only for temperatures between 0° and 25°, but will be pushed further up to 100°.—Dr. Pringsheim described an ingenious procedure by means of which he had succeeded in obtaining positives of old manuscripts on which old and faint characters were obscured by newer and dark writing. The positives were obtained by a combination of several photographs, and showed only the older and fainter characters in sharp and clear definition.

June 15.—Prof. von Helmholtz, President, in the chair.—Prof. von Bezold gave an address in memory of Prof. A. Kundt, the Vice-President of the Society, recently deceased, in which he dwelt upon his scientific labours, and in particular upon his distinguished efforts as a teacher.

NEW SOUTH WALES.

Royal Society, May 2.—Prof. Anderson Stuart delivered the presidential address. He gave a detailed account of the poison of *Ornithorhynchus paradoxus* and of the poison of the "Bush-tick," and alluded to that of the Australian varieties of the spider-genus *Lathrodectus*. After describing the present

favourable state of the arrangements for an expedition to one of the South Sea atolls, to realise the suggestion of Darwin to bore and bring up a core, and thus probably settle the question of the origin of the atoll, he announced that, acting on behalf of the Committee of the British Association, he had secured the loan of a diamond drill from the Government of New South Wales. He also spoke of the artesian water supply of the colony in reference to the probable limits of its supply, and favoured the naming after Darwin of some place in the Blue Mountains associated with Darwin's visit. He then reviewed certain questions of present importance in the colony, such as the disposal of sewage, the characters of sewer-air, and the backward condition of sanitary legislation in the colony, &c. The Society is maintaining its position very well, in spite of the present extremely adverse circumstances of the colonies. The officers and council were elected for the ensuing year, Prof. R. Threlfall being President.

Linnean Society, May 30.—Prof. David, President, in the chair.—Notes on the methods of fertilisation of the *Goodeniaceæ*, by Alex. G. Hamilton. Three species of *Scævola*, one of *Selliera*, and one of *Brunonia* were dealt with. The writer concluded that although there is an elaborate contrivance in the first four for securing cross-fertilisation by the aid of insects—which was described in detail—yet, if that fails, self-fertilisation occurs. *Brunonia* was said to be anomalous in its methods. The process of fertilisation in the three allied orders—*Lobeliaceæ*, *Goodeniaceæ*, and *Campanulaceæ*—was contrasted, and it was shown that the same end is secured by widely different adaptations of the same organs.—On three highly ornate boomerangs from the Bulloo River, N.S.W., by R. Etheridge, junr.—Note on the tertiary fossils from Hall Sound, New Guinea, by Prof. Ralph Tate. The author's observations were based on an examination of the specimens in the Macleay Museum, obtained during the voyage of the *Chevert*. These were reported on by the late Rev. J. E. Tenison-Woods (*P.L.S.*, N.S.W. 1878, ii. (2), pp. 125 and 267), who referred them "to a very recent tertiary formation, much newer than any of the Murray River or Western Victorian beds." The author concurred in this view, but pressed for a more recent origin than that implied by Tenison-Woods—even Pleistocene. Some critical observations on the specific determination of the specimens were given—a matter of some difficulty in most cases by reason of their imperfect condition.—On the morphology of the muscles of the shoulder-girdle in monotremes, by W. J. Stewart McKay. The author has found a clavicular deltoid present in both *Echidna* and *Ornithorhynchus*; also a pectoralis quartus, teres minor and subclavius. The teres major is single in both forms; the sub-scapularis of great extent. Much attention has been given to the nervous system, and elaborate dissections have been made to trace out "the latent cutaneous nerve of the thorax" (Patterson) and its communication with the intercostal nerves.—Description of a new Australian snake by J. Douglas Ogilby. The habitat of the new species (*Hoplocephalus waitii*), which differs mainly from *H. pallidiceps*, Günth., in having 21 series of scales round the body instead of only 15, appears to be the central district of N.S.W., whereas *H. pallidiceps* is a North Queensland form.—Fishes new or rare on the Australian coasts. By Edgar R. Waite. The fishes dealt with were from Maroubra, N.S.W., and are either new to Australia or of exceedingly rare occurrence, and with two exceptions obtained for the first time on the coasts of this colony. The species mentioned are:—*Dules argenteus*, Bennett, *Acanthurus triostegus*, Linn., *Psenes whiteleggii*, sp. nov., *Nomeus gronovii*, Gmel., *Schedophilus maculatus*, Günth., *Glyphidodon brownriggii*, Bennett, *Solenognathus hardwickii*, Gray, *S. spinosissimus*, Günth., *Monacanthus filicauda*, Günth., *M. nitens*, Hollard, and *Leptocephalus*. The author expressed the opinion that *Solenognathus fasciatus*, Günth., is not specifically distinct from *S. spinosissimus*.—Description of a new mite belonging to the genus *Heteropus* found in wasps' nests, by W. W. Froggatt. The name *Heteropus alastori* was proposed for a mite which has been found in great numbers in the clay nests of the solitary wasp, *Alastor eriurgus*, Sauss., in the neighbourhood of Sydney. The gravid female has an immense globular abdomen eight times the length of the head and thorax combined.—On the mode of attachment of the leaves or fronds to the caudex in *Glossopteris*, with remarks on the relation of the genus to its allies, by R. Etheridge, jun., with note on the stratigraphical distribution of *Glossopteris* in Australasia, by Prof. T. W. Edgeworth David. The fossil plant *Glossopteris*, which formed the predominant type of swamp vegetation in Eastern Australia during the Permo-Carboniferous Period, when the productive coal-measures were being formed, has left records of its former presence almost invariably in the form of leaves only. Only two authentic cases have been recorded of *Glossopteris* leaves having ever been found attached to any kind of stem, previous to the discovery of the specimen found near Mudgee by Mr. J. C. McTaggart, which makes the third specimen ever discovered, and which was described by the authors. The specimen shows that some variety, at all events, of *Glossopteris* in Australia had somewhat the form of a dwarf tree-fern, with a caudex, or stem, at least six inches in length, and surmounted by a clump of closely packed fronds to the number of about eight. The fronds, as proved by the scars on the caudex, were not placed on a verticil, but spirally on the caudex. They are sessile, not petiolate as in the case of the specimen described by Prof. Dana from Illawarra.—Mr. Hedley read the following note:—"From the throat of a *Rallus pectoralis* Mr. J. A. Thorpe of the Australian Museum extracted the snail I now exhibit. This is a specimen of *Chloritis jervisensis*, Quoy and Gaimard, a species common in this neighbourhood, whose almost adult and uninjured shell measures 18 mm. in diameter, and which weighed, shell and animal together, 1·26 grammes. When found by Mr. Thorpe, to whom I am indebted for both facts and specimen, the snail was quite dead; as a test I immersed the animal in strong spirits without inducing contraction; since, however, its consumer had been killed forty hours earlier, the suffocation of the mollusc was to be expected. The bird was shot at Randwick, near Sydney, on May 19, 1894, by Mr. Newcombe, Deputy Registrar-General. In enumerating 'Means of Dispersal,' Darwin observes ('Origin of Species,' 6th ed. p. 372): 'A bird in this interval [eighteen hours] might easily be blown to the distance of 500 miles, and hawks are known to look out for tired birds, and the contents of their torn crops might thus readily get scattered.' In view of the above incident, this suggests a means whereby the geographical range of *jervisensis* might be considerably extended."

CONTENTS.